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THE WAVE LENGTH OF RÖNTGEN RAYS.

Practically all the results of experiment have so far pointed to the truth of the hypothesis that Röntgen rays differ from ordinary light rays and other manifestations of radiant energy only in the item of wave length. The supposition that they are radiations of almost inconceivable frequency of vibration and having a wave length many times less than that of violent light is a competent explanation of most of the phenomena due to them, leaving their remarkable action in discharging electrified bodies and certain other as yet dimly comprehended actions for further explanation. These, however, do not seem inconsistent with the theory that the Röntgen ray is simply an ordinary transverse ether vibration of high frequency.

In another column is a translation in abstract of a recent article by Mr. J. Precht, giving an account of some experiments with cathode and Röntgen rays. Three different determinations of the wave length of the Röntgen rays resulted in widely varying figures, the lowest wave length found being 0.00016 millimetre. The result of the experiments, assuming that they are all entitled to equal weight in consideration, simply leads to the negative conclusion that the wave-length measurements obtained by them are entirely indeterminate. If the assumption is permitted that the wave length of Röntgen rays is so small as to be comparable to molecular sizes, it can be readily seen from physical considerations that the phenomena of refraction and diffraction would not manifest themselves, or at least not in the manner with which we are accustomed; and that no surface would give such reflection as may be had with ordinary light waves, but rather that each surface upon which Röntgen rays impinge would become a new source of diffused radiation of the same character. It seems that no method of wave-length measurement that has been utilized for the determination of the elements of wave motion of ordinary light would be satisfactory for the determination of these incomparably finer vibrations, and that the grossness of structure, even of such bodies as we are accustomed to consider as having high refractive indices, will probably permit these rays to go through them in much the same fashion that a light ray shines through a swarm of flies.

STRAINS IN ELECTRIC RAILROAD POWER HOUSE ENGINES.

There has lately arisen considerable discussion between prominent engineers in England and America on the subject of the design of engines for traction generator driving and the question of the stresses in such engines. One gentleman on the other side of the water claims that the strains in engines used for such purposes are no greater than in those used for other purposes, and the American practice of building such engines extra heavy is foolish. An American designer, on the contrary, holds the opinion that the strains are much greater, and the engines should be built as heavily as possible, which is certainly an extreme view. In a certain way both seem to be right, as a little careful thought will show.

Considering an engine and direct-coupled dynamo carrying a light load which is abruptly changed to full load, or even short circuit, the governor, if extremely prompt, may change the cut-off between two successive strokes practically from zero to full cylinder admission. The strains on piston, piston rod, cross head, con-

necting rod, crank and frame, are solely those due to the action of the steam on the piston and the inertia of the moving parts, and it is hard to see how they will be any worse in the case of a stroke with full steam following a short cut-off, than in the case of a continuous full load, every stroke being made with full steam. On the other hand, with this abrupt change of load, and especially with momentary short circuits, there comes a retarding force which taxes enormously the stored kinetic energy of motion of the fly-wheel rim. This sudden call for a large amount of energy introduces a heavy bending strain in the fly-wheel spokes, a powerful twist in the shaft between the fly-wheel hub and the armature spider, and a tremendous tangential pull on the field magnet poles. But outside of these parts it introduces no unusual strain whatever, except, possibly, very slight ones on the reciprocating parts, due to the change of the angular velocity. It would seem as though the engine whose frame and parts were designed to stand safely the stresses due to the full boiler pressure on the piston would be plentifully rigid for traction work, with the exception of the fly-wheel, main shaft and the parts holding the generator, since the stresses in the other par. are only those due to the steam pressure, which is no greater when the engine is carrying a variable load than when the load is constant.

The English advocate of light engines has suggested the abolition of the fly-wheel on engines in which the cranks are sufficient in number, and properly arranged, for a fairly uniform torque around the circle. One effect of such a change would, of course, be to reduce greatly the strains in the dynamos, and the tremendous rushes of current on occasions of low external resistance, but the enormous variations of the line voltage and the engine speed which would ensue in ordinary traction work would be absolutely prohibitory to such a plan.

CONVENTIONS IN ELECTRICAL DIAGRAMS.

In line with the need of a widely-recognized uniformity of electrical terms mentioned in the last issue of The Electrical World, there is also a great need for a generally used system of conventionalized signs in electrical diagrams. Particularly is this noticeable in patent-office work, where draughtsmen of widely-varying tastes and knowledge of the subject have developed all sorts of diagrammatic representations for the same detail. For a simple example, the saw-tooth line used by some to represent the field-magnet winding is meant by others for a non-inductive resistance. There is no proper distinction between storage and primary batteries, and the distinction between either and the condenser is not always recognized. Vectorial diagrams of multiphase transforming systems have been attempted, but not consistently worked out, and diagrammatic representations of rotary converters are made in all sorts of ways. A petition to the Commissioner of Patents has been prepared, and is being circulated among the prominent electrical attorneys, asking him to instruct the examiners in the electrical divisions to work out a logical and symmetrical set of signs, to be published in an official order.

A generally recognized set of letters and symbols for the analytical discussion of electrical phenomena would be also of great value. Some writers use the capital letter C to signify current; others use the capital I, while still others use the capital I to mean induction, while the distinction of instantaneous, maximum and virtual values of alternating current properties is very much mixed. The adoption of a set of such symbols, which should be international, and preferably inter-lingual, their meanings to be, wherever possible, as clearly understood as that of the Greek letter π, would be a great gain to the electrical author, editor and patent worker.

MULTIPHASE MOTORS FOR TRACTION.

There can be little doubt that the direct-current motor for traction purposes is doomed to disappear in the course of no great length of time. It is interesting to note that recent installations of three-phase systems for railway propulsion have proved successful, one of them being mentioned in this issue. On this particular road, which ascends the Gorner Grat, in Switzerland, a 12 per cent. gradient is encountered, and both the ascent and descent of this are effected without difficulty. The road at Lugano, Italy, has been in successful operation for some time.

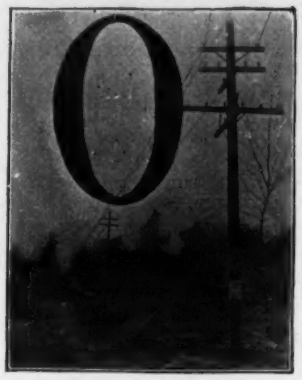
The advantages of the three-phase motor are so obvious, and so many, that it is hard to see why more general effort has not been made for its introduction for traction work. The problem of long-distance transmission is solved at once by the use of high pressures and voltage transformers feeding sections of the road. The problem of starting such motors with sufficient torque is no longer a difficult one, and the maintenance of schedule speed up and down grade, especially with some variety of synchronous motor system, is more easily possible through this means than through any other. The substitution of such motors for the direct-current form accomplishes two very important results at once—the elimination of commutator troubles at both the motors and the generators, and the great decrease of copper necessary for proper line feeding.

It may be contended that the three-wire system of feeding necessary for three-phase motors will cause considerable trouble in the installation of such systems. This is by no means necessarily true. The experience of the recently constructed conduit railways in Washington and New York show with what admirable success the two-conductor or double trolley system can be worked in a conduit. All that would be necessary to add to such a system as this for the working of three-phase motors upon it would be proper track bonding, and the utilization of the rails as one of the three leads. The difficulties of electrolysis would be practically eliminated by the alternating character of the currents in the rails, while the enormous copper cables, now necessary for the feeding of heavy surface roads, such as those mentioned, would be replaced by smaller wires and occasional transformers in manholes.

With an overhead system other difficulties, of course, present themselves, which are well known to those who remember the early days of double trolley electric traction in this country. When the case of suburban traffic on private rights of way is considered, however, these difficulties disappear, since a more solid construction of conductors mounted directly upon the cross ties, or something approaching a third or fourth-rail system, may be adopted with entirely satisfactory results. The simplicity of the motors is so great that they commend themselves to the careful consideration of traction engineers. The no less great simplicity of the generating mechanism also recommends itself, while the possibility of locating the generating station of such a system at a point where maximum economy in steam power production, fuel delivery, etc., may be had, irrespective of its situation with regard to the line, is another element which must work for the future success of this type of railway.

In the larger cities the movement to compel the introduction of underground trolley or conduit systems to replace the overhead construction hitherto employed has become very general, and with the object lesson furnished by the magnificent installations now in progress must become even more widespread. The opportunity is offered in such systems to utilize alternating current motors. It is to be hoped that this opportunity will not be lost, and that a large installation of this character may be put in.

The Newcastle-Sacramento Transmission Plant.

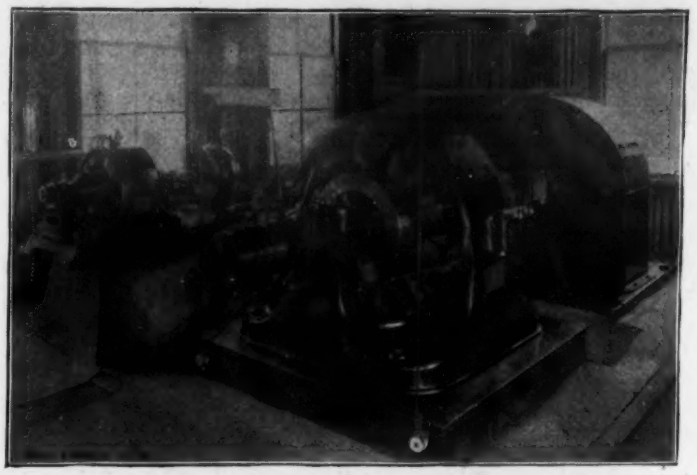


ON the Sierra Nevada divide, northeast of Sacramento, Cal., the South Yuba Water Company owns and operates an enormous irrigating system, with nineteen storage basins, over 400 miles of canals, thirteen distributing reservoirs, and a network of canals, flumes, tunnels, pipe lines and lakes, covering two counties. At various points on the canal system are "drops," or sudden falls. The most important "drop" is one of 464 feet, of which 400 feet is utilized for the driving of the power plant of the Central California Electric Company, a corporation closely allied to the South Yuba Water Company.

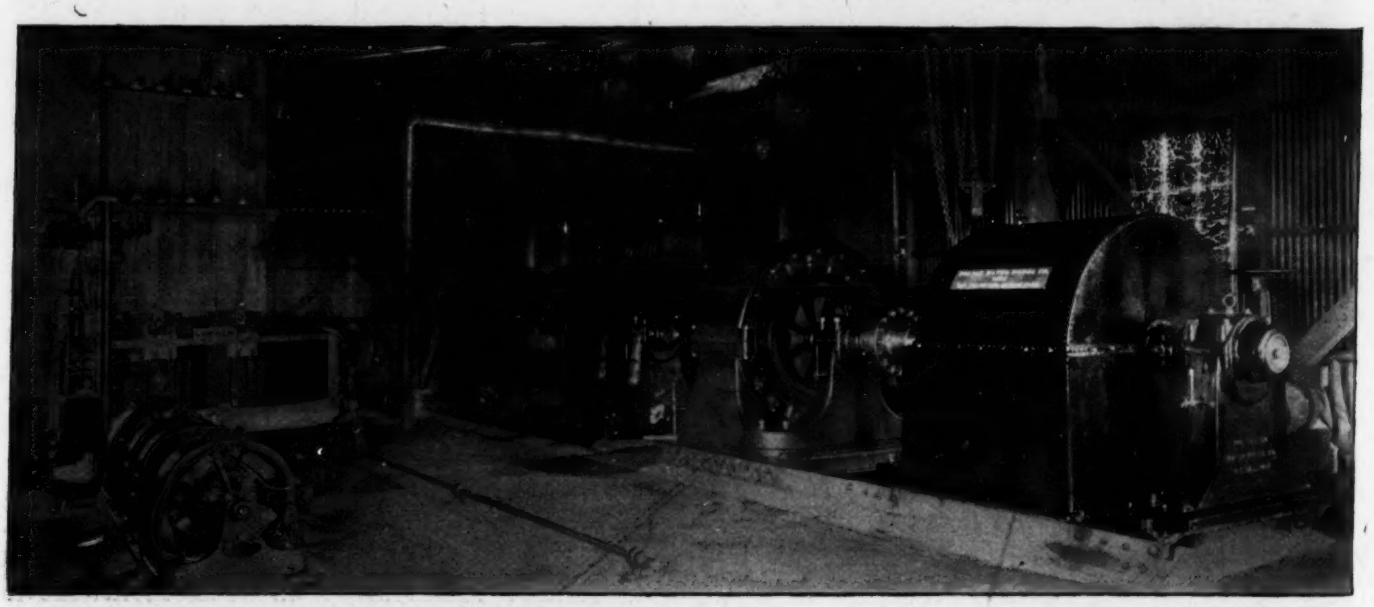
The water is carried from a reservoir to the power house, a distance of 6400 feet, in a 24-inch pipe of riveted sheet steel. The pipe is buried about 2 feet underground. Its thickness increases as it approaches the power house from No. 12 to No. 6 B. W. G. At the power house the pipe forks, in a heavy cast-iron Y, into two 15-inch pipes of No. 6 steel, running to the Ys on the Pelton water wheels.

These wheels are a special design of the double pattern, two 48-inch wheels being direct coupled to each of the two 400-kw generators. The wheel buckets are of the Dodd pattern, with nozzles arranged to be deflected by means of hand levers located near the switchboard. No automatic water-wheel governors are used, the regulation being effected manually by the switchboard attendant. This does not require very close attention, as "the plant runs under a load so evenly laid on or taken off that every change can be anticipated, and even a waste of water avoided." The tail races are of substantial construction, and have heavy granite slabs at the bottoms. The power house foundations are about 6 feet deep, and of concrete and granite. The building itself is 80 feet by 30 feet, and its sides and roof are constructed of corrugated iron on a wooden framework.

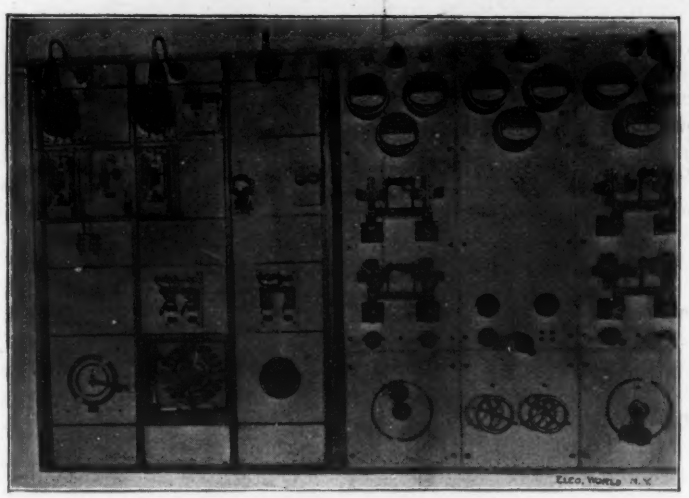
The Westinghouse Electric & Manufacturing Company supplied the entire electrical equipment of this plant, consisting of:



LOCAL LIGHTING PLANT IN GENERATING STATION.



MAIN WHEELS, GENERATORS AND EXCITERS.



THE MAIN SWITCHBOARD.

Two A. C. two-phase generators.

Two exciters.

Generator switchboard.

Step-up transformers, two-phase 500 volts to three-phase 15,000 volts.

Twenty-eight mile three-phase 15,000-volt transmission line.

Fifteen thousand volt receiving switchboard.

Reducing transformers, three-phase 15,000 volts to two-phase 2000 volts.

Distribution switchboard.

Two-thousand volt circuits.

Transformers for motors and lights.

The two 400-kw generators are of the inwardly projecting field and revolving armature type, and run at a speed of 400 r. p. m. They generate two-phase alternating current of 7200 alternations per minute, at 500 volts. The armature is not wound with wire, but with copper straps of the form and dimensions best suited to the armature slots. Each coil consists of a single turn of this copper strap, which is thoroughly insulated before it is placed in the armature grooves. After the coil is in position, strips of fibre are placed in each slot just over the bar and held in place by fitting into small grooves in the sides of the slots. Ventilation of the armature is effected by a number of radial openings between the laminations, from the open spider to the surface. The machines are excited by two 15-kw 125-volt exciters, driven by separate wheels, each exciter having ample capacity for exciting both of the generators.

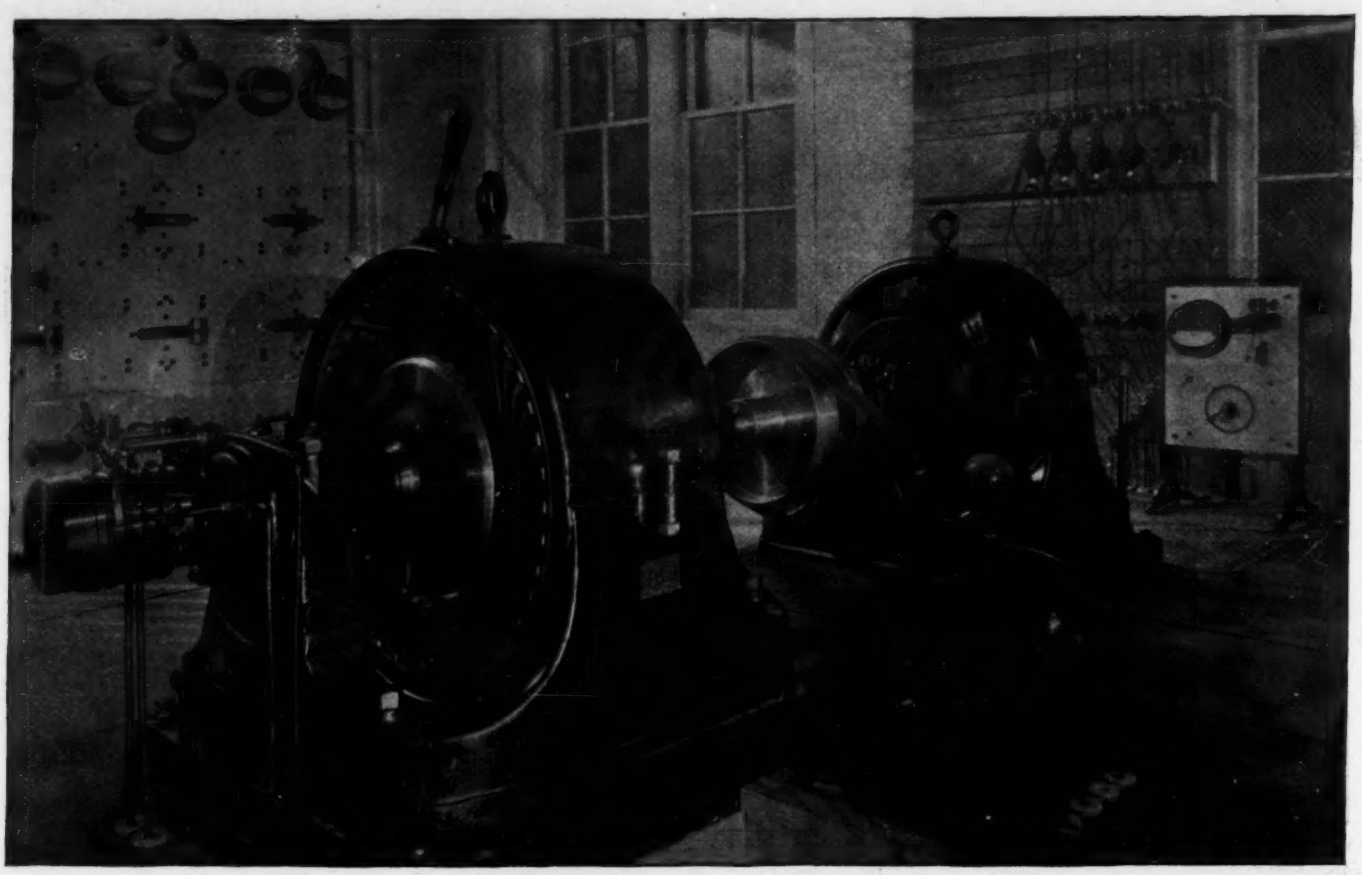
The wires from the machines lead directly to the main switchboard, which consists of three panels, one for each generator and one for the exciters. Each generator panel is provided with two double-pole carbon-break main switches, an ammeter in each phase, a voltmeter on one phase, plug switches for the field circuit, and a rheostat. On one of the generator panels there are two lamps, which are used in synchronizing the machines. The middle panel contains the rheostats, switches, ammeters and voltmeters for the exciters.

At one end of the board on a swinging arm is a voltmeter, connected with a compensator mounted on the back of the board. This voltmeter indicates the pressure on one of the phases, and the compensator introduces a drop corresponding to that in the main transmission circuit, so that the instrument indicates the pressure at the sub-station in Sacramento. When there is a light load and a small drop the compensated voltmeter and the voltmeter on the generator panel will read practically the same, but when there is a full load the E. M. F. on the generator must be increased until the compensated voltmeter gives the proper indication. The difference between the indications of the voltmeter connected to the bus bars and that on the compensator obviously gives the drop in the line.

Each generator is connected directly through the switches on the switchboard and fuses to the primary of the step-up transformers, which are connected to transform from two phase to three phase, and deliver current at 15,000 volts to the transmission line. Four step-up transformers, each of 150 kilowatts, are connected on the Scott system in two pairs of two transformers each for the two-phase three-phase transformation. The terminals from each set of transformers are connected through fuses directly to the transmission line. Both step-up and step-down transformers are oil insulated. The coils of the transformers stand in vertical planes, and are spread apart to allow a free circulation of the oil between the coils, thus securing a high insulation and enabling the oil to come in close contact with various parts of the winding, and convey the heat to the case by convection. Ample provision is made for cooling by air circulation without the use of water jackets or fans, but by the simple provision of vertical air tubes through the walls of which the heat is transmitted from the oil to the air.

The pole line is substantial and well constructed. For five miles redwood poles, 30 feet long, 10 inches square at the butt, and 6 inches square at the top, are planted 5 feet in the ground. For the remaining 23 miles the poles are 40 feet, long of Washington cedar, and planted 5½ feet deep. The distance between the poles is 125 feet. The cross arms are 5 feet long, with two pins and two insulators. One set of insulators is secured to the peaks of the poles, on iron Ys. There is a light arm also attached to the poles for telephone wires. The three wires of the main circuit are No. 4 B. & S. bare copper, secured one to the insulators on the peaks of the poles and the others to those on the top cross arm.

The second cross arm carries the wires for local service in Placer County. The insulators are of the Locke pattern, triple petticoat, and made to carry a current of very high potential without cracking or puncturing. They are secured to the cross arms by steel pins, thus providing a solid support for the wires. General Manager Van Norden states that these insulators have proved very satisfactory for the transmission of 15,000 volts. The line worked perfectly when the plant was first put in operation, and only a few of the 6000 insulators have developed any weakness since they were put in service. Some of these appear to have been broken by malicious shooting or by other non-electrical causes. When these accidents occurred the poles were set on fire by the current, which, however, did not interrupt the service as the pole burned away, leaving the wires hanging free. On one occasion two poles nearly a mile apart were found to have been burned, owing to faulty insulation, which allowed the current to leak from one wire through one of the poles to the ground, and back through the other pole to another wire of the circuit. Both of these poles were badly burned, but neither the attendant at the generating station nor the attendant at the sub-station knew that anything unusual had happened.



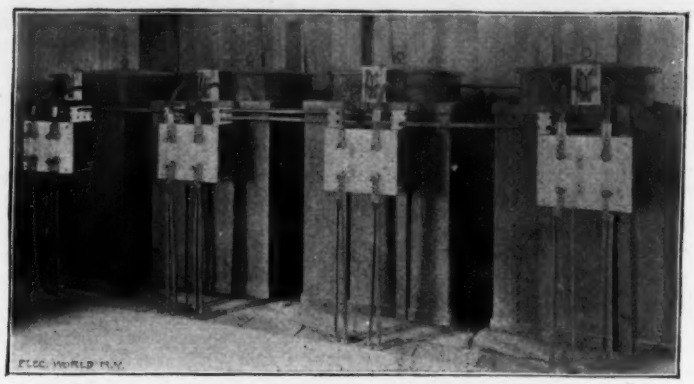
Multiphase Motor Driving Arc Generator.

Each end of the transmission line is protected by Wurts non-arcing metal lightning arresters. There are six choke coils connected in series in each of the three wires. From the line at the junction with the coils there are spark gap paths to the ground, through which lightning discharges can pass. No resistances are introduced in the ground circuits, so the lightning discharge encounters nothing except the spark gaps on its way to the earth.

At the sub-station at Sacramento the current is received on a high tension switchboard panel, by which it may be delivered to either or both of two sets of step-down transformers. Fuses are inserted between the panel and the transformers.

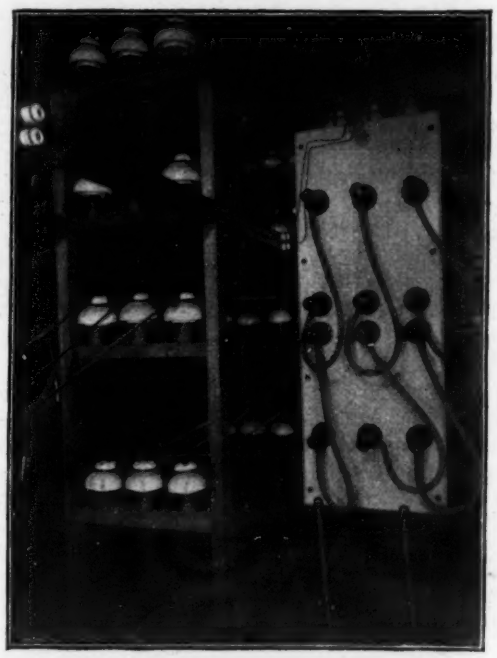
Special precautions were taken in the design of the fuses and switches for use on this high tension circuit to secure safety, as well as reliability and simplicity. The fuse terminals are enclosed in hard

rubber fittings, which are supported on high tension triple petticoat insulators. The fuse is of fine wire, a foot or more in length, enclosed in a rubber tube. The contact between the fuse and the terminal is made by a screw which is entirely covered by a hard rubber cap. The high tension switchboard consists of a marble panel, with receptacles at the middle for the line terminals, and at the top and bottom for the terminals of the circuits to the step-down transformers. Connection between receptacles is made by plugs connected by flexible cable. The receptacles are entirely enclosed in hard rubber, so that there are no contacts exposed at any time. The plugs and the cables joining them are thoroughly insulated.



STEP-UP TRANSFORMERS.

Detachable wooden handles are used for handling the plugs when they are to be inserted or withdrawn on a live circuit. An insulated floor or platform is arranged, on which the attendant stands when making connections on this switchboard. To prevent accident in case of a breakdown in insulation, or dampness on the surface of the plugs and handle, a special device is used to effectually protect the attendant from the current. Near the middle of the handle there is fastened a chain, which is connected to the ground, or the support of the floor on which the attendant stands.



HIGH TENSION PLUG BOARD.

The latter is therefore thoroughly protected, as the escaping current has two paths between the terminals of the chain, one through the low resistance metal chain, and the other through the wooden handles, the operator and the wooden platform, the resistance of the latter compared with that of the chain being so great that the attendant is effectually protected.

In the sub-station there are three pairs of 75-kw step-down transformers, which receive three-phase current and deliver two-phase current at 2000 volts to the bus-bars of a distributing switchboard.

This switchboard is provided with throw-over switches, by which either circuit may be thrown on either phase desired; and with fuses enclosed in lignum-vitæ holders, ammeters and voltmeters. The distribution at 2000 volts is similar to that from ordinary 2000-volt dynamos. The circuits are supplied with standard transformers for reducing the current from 2000 volts to 100 or 200 volts, as may be desired. Transformers are used for ordinary lighting work and for the supply of two-phase motors, and also by simple combinations for the supply of three-phase motors.

In the sub-station are two 50-hp induction motors, direct-coupled to 60 light D. C. series machines for supplying arc lights. These induction motors are supplied by two 75-kw transformers, which deliver two-phase current at 2000 volts.

Special attention is called to the use of a new protective arrangement, with which the high tension transformers are all supplied, the non-arcing metal spark gap protector. This protector is connected between the low tension coil and the ground, and prevents the great rise of E. M. F. between this coil and the ground, which might occur either in the case of a breakdown of the insulation between the high and low tension coils in the transformer, or which might be caused under certain conditions by static induction between the two windings. The protector consists of a spark gap, similar to that in the well-known non arcing lightning arresters, one side of which is connected to the ground and the other side to the middle point of the low tension winding. The normal E. M. F. of the low-tension coil is not sufficient to cause sparking across this gap, but in the case of undue rise of E. M. F. the current jumps across this gap and connects the coil to the ground, thus affording protection from the dangers which would arise if the low tension circuit were at a great difference of pressure from the ground.

The plant has been in regular and successful operation for a year. There have been very few shutdowns, and those for brief periods only. The plant is shut down for a few minutes every Sunday morning for a general inspection and cleaning of the apparatus.

The perfect success attending the transmission of power for a distance of nearly 30 miles, involving the use of nearly 6000 insulators on a 15,000-volt circuit, is the best testimony in the world of the superior excellence of every part of the apparatus, and the extraordinary care that attended its installation. New proof is given that successful long-distance transmission is in a state of rapid transition from the field of experiment to that of practical engineering.

The Central California Electric Company was organized by Mr. Warren Van Norden, president of the South Yuba Water Company. The work is in charge of General Manager Charles Van Norden, to whom, as well as to Mr. W. M. Probasco, of the Westinghouse Company, thanks are due for the information and illustrations contained herein. The electrical work is in charge of Mr. E. W. Sutcliffe, superintendent and electrical engineer for the company.

The New York Rapid Transit Subway.

It was expected that the Appellate Division of the Supreme Court would hand down a decision on December 10 concerning the advisability and feasibility of constructing the proposed $30,000,000 rapid transit underground road in Manhattan Island. This decision is the last legal hindrance to the construction of this road, which has been fought for by the community in general, and fought against by the competitive interests now in the field, for so long. The commission appointed by the Appellate Division recently rendered a report of the most favorable character, and the Appellate Division has only to adopt or reject this report to allow or prevent the construction of the system. One of the necessary requirements previous to the letting of the contract is three weeks' notice, and it is claimed by the opponents of the road that, now that the contract cannot be let before the consolidation of Greater New York, the new boroughs entering the city will have to be consulted, and the whole preliminary legislative work done over again. The rapid transit commissioners, however, claim that the consolidation will not have the slightest effect on the work. It is said that a syndicate has been formed of New York and foreign bankers and prominent New York construction firms to contract for the construction, and that this syndicate is ready to give the necessary bonds, make the deposit of $5,000,000, and start right ahead as soon as the decision is rendered. The rapid transit commission has appointed a board of two civil engineers and one real estate expert to co-operate with Chief Engineer Parsons in preparing the details of the contract specifications.

Experiments with Cathode and Röntgen Rays.*

BY J. PRECHT.

I.—DEVIATION OF CATHODE RAYS BY A MAGNET.

The cathode rays were produced either in spherical tubes carrying cathodes surrounded by glass up to their inner ends, which were at the centre of the spheres, or in cylindrical tubes with cathodes similarly enveloped and directed along the axis of the cylinder. (Figs. 1, 2 and 3.) In certain experiments the anode, an aluminum cylinder almost surrounded the cathode, the front of the cylinder being only 3 millimetres from the free end of the cathode (Fig. 4). The phenomena observed were photographed, this presenting, however, certain difficulties on account of the spreading of the cathode cone. To diminish this the end of the cathode was encased in a short sheet of steatite. The plates were also intensified or weakened during development, as seemed necessary.

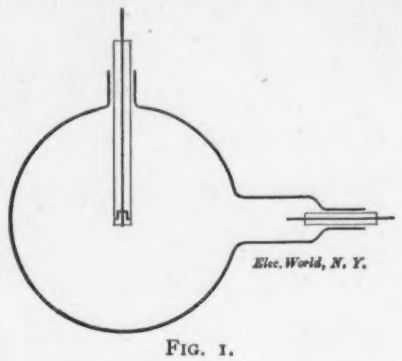


Fig. 1.

The plates show that the cathode rays traverse a spiral around the direction of the magnetic field, and that, in a way, the deviation follows Ampere's law, if the rays be considered as currents in the cathode directed toward the interior. When the direction of the cathode rays is normal to that of the lines of force of the magnetic field the cone of rays forms a ring about the lines of force; when the angle between the lines of force and the rays is either obtuse or acute the cone rolls itself up into a spiral, which is directed toward or away from the pole. Since it is impossible to obtain a beam of cathode rays in which all the elements are mutually parallel (because any diaphragm used becomes a secondary cathode), these spirals appear in nearly all deviation experiments. The lack of homogeneity of the magnetic field introduces large errors in the theory of deviation. In a field which is as nearly homogeneous as possible those rays which are parallel to the lines of force continue in their course, while the others roll up into spirals around them. When the cathode is equatorially placed the entire discharge appears to simply follow the direction of the lines of force, whereas in general the principal part of the discharge forms a ring around these lines. The ring is actually present, but of small diameter on account of the intensity of the magnetic field, so that it is not visible at first in the luminous mass in the tube.

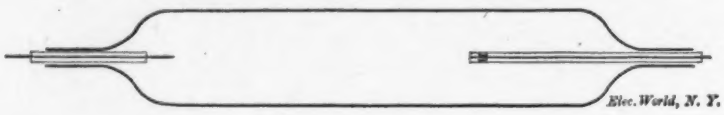


Fig. 2.

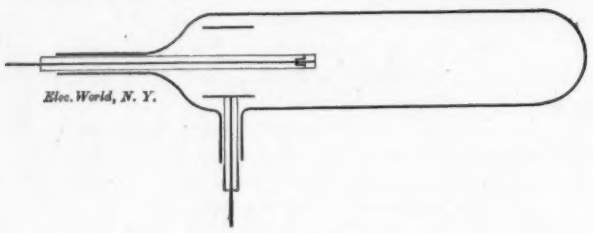


Fig. 3.

When the cathode rays, deviated by the magnetic field, impinge upon any point of the glass walls of the tube, that point becomes the source of a new cathode stream. This is directed as if it were reflected from a surface normal to the lines of magnetic force. This reflected stream obeys the forces existing between its particles and the magnetic field, which explains why, in certain experiments, a luminous arc appears, flowing back toward the cathode. The presence of this arc proves that the incident rays form an acute angle with the vertical plane of the pole faces of the magnet—that is, if the cathode is in this plane. The arc disappears because it is confounded with the incident arc. Helicoidal surfaces can be seen in the reflected arc, when the tube is so placed that the arc grazes the walls for a little distance, by the appearance of the fluorescent streaks which are produced upon the glass.

The "tubular rays" (*rayons canaux*) of Goldstein are not deviated by the magnetic field, however intense this may be.

For all rays, however, that are deviated by the magnetic field, the law of Ampere and the law of Biot and Savart are satisfied. The phenomena are in accord with the hypothesis that the part of the cathode stream affected by the magnetic field is formed of negatively charged particles. Of the size of these particles it can only be said that it is evidently very small—similar to that which present theories assign to physical or chemical molecules. When the pressure in the tube is increased, the sensitiveness of the cathodic light to the magnetic field decreases. Below a pressure of 15 millimetres, in certain tubes, the blue light becomes invisible, but the invisibility seems dependent upon the form of the tube. It results from a very high cathodic resistance (the resistance to the penetration of the discharge offered by the dark region). If a discharge is made to strike in air at ordinary pressure between two electrodes placed, like those in the tube, normally to the axial plane of a powerful electromagnet, the positive and negative luminosities separate, and the latter is deviated as a cathode stream would be.

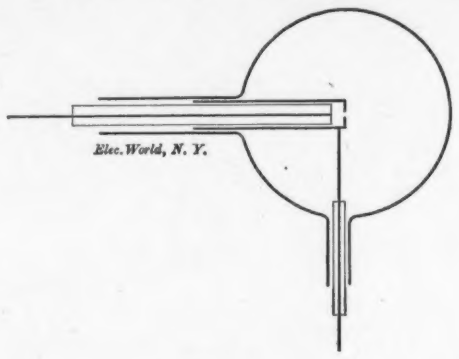


Fig. 4.

2.—PROPERTIES OF RAYS EMERGING FROM DISCHARGE TUBES.

The Röntgen rays are not identical with Goldstein's "tubular rays" (*rayons canaux*), because these latter traverse neither glass nor black paper. The Röntgen rays, of which mention will be made below, were generated by an ordinary pear-shaped Crookes tube. The cathode was a plane aluminum disc, 20 millimetres in diameter, the anode being a similar disc of 10 millimetres diameter. The cathode was normal and the anode parallel to the axis of the tube.

When such tubes are operated they experience two varieties of change. Their resistance augments and the glass exposed to cathode stream becomes transformed and ceases to be phosphorescent.

Fluorescence Phenomena.—The fluorescence of various substances possessing this property can be greatly influenced by the presence of small quantities of foreign matters, as several authors have already stated. The photographic action of Röntgen rays was found to be particularly intense when the tube is closed by a window of magnesium, especially if this be very thin. The most sensitive photographic plates are those of the gelatine-bromide variety, their sensitiveness to Röntgen rays corresponding to their sensitiveness to light, as already stated by MM. Lumière.

Fluorescent bodies hasten the photographic action, especially platino-cyanide of potassium, which is much more transparent than the majority of others, but which unfortunately possesses the disadvantage of a granular structure.

The intensity of the light emitted by fluorescent crystals increases progressively up to a maximum, and then slowly decreases after exposure to the rays has ceased. The time required to attain a maximum differs, naturally, in different crystals. Some become immediately luminescent, others only after an interval of some minutes. In the latter case, the luminescence is slower in disappearing. In bodies which are only fluorescent, and which cease to shine

* Abstracted from *Wiedemann's Annalen*, LXI., p. 330.

after the exposure to the rays has ceased. It may happen, on the contrary, that they do not begin to glow until some seconds after commencement of exposure to the rays. For example, if the hand is interposed between a tube and a screen of barium or calcium platino-cyanide, at first the shadow of the whole hand appears. Then the flesh becomes more and more dim, until the bones stand out sharply defined. The phenomenon is not subjective, because no difference is noted if the observer does not open his eyes for some seconds after the hand has been interposed. It is not due to any change in the activity of the tube, since it is equally well observed after the tube has been in operation for some time. This appearance is not visible with all tubes, and shows best with feeble currents. It certainly does not result from an undulatory motion, because there is no reason why the transparency of a body should change, unless accompanied by a chemical transformation.

The author compared the transparencies of a number of minerals. That of tourmaline, in sheets of the same thickness, varied notably with its origin. Struvite is very transparent, even in considerable thicknesses. Calamine (silicate of zinc) is found to be, on the contrary, almost opaque in comparison with emerald or topaz.

Röntgen rays do not possess, like cathode and discharge rays, the property of coloring salts, but they lower the resistance of selenium like light rays (32 per cent. in these experiments diffused daylight giving 65 per cent.) Refraction, with steel and copper prisms, is very feeble, if any really exists, and the index of refraction does not differ from unity by more than ± 0.0003. With prisms of glass and aragonite the deviation was distinct, and

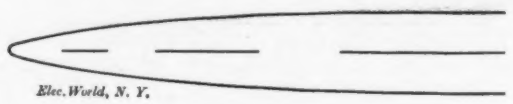


FIG. 5.

changed its sign when the prism was reversed. It is not, therefore, due to errors of observation, but may be due to the increasing absorption toward the base of the prism. The corresponding index seems to be between 1.002 and 1.004.

Diffraction of Rontgen Rays.—Many experiments made with platinum wire gratings failed to show any results. While rejecting the idea that the fringes observed by different experimenters were due to reflections of rays grazing the jaws of the slit, when these were thick, the author sought to favor this hypothesis. In his first experiments the edge of a lead wire two millimetres in diameter was placed in front of a very narrow slit, whose jaws were very thin, and behind the slit the sensitive plate was exposed. The rays grazed the surface of the lead wire, passed through the slit, and impinged upon the sensitive plate, upon which were thus obtained two regions—one subject to the direct radiation and the other not. At the limits of these two regions there appeared very distinct interference fringes. By comparing the distances apart of the fringes and of similar bands similarly obtained from sodium light, the wave length of the Röntgen rays was found to be, by two absolutely independent series of measurements, from 349 to 367 millionths of a millimetre.

In other experiments, where the rays traversed two slits, the fringes only appeared when a silvered mirror was placed in the beam issuing from the second slit. In this case they are never very sharply defined, for even in the regions of minimum energy and in the geometrical shadow the plate suffers some alteration. Beyond doubt this demonstrates that the rays are diffused, and also that every body upon which Röntgen rays fall becomes a secondary source of emission for similar rays, which are propagated in all directions from it. From the width of the fringes in these experiments the wave length was calculated to be between 784 and 883 millionths of a millimetre.

The radiograph of a small needle placed in front of a lead diaphragm, in which is an exceedingly small hole giving a very sharp cone of rays, is shown in Fig. 5. In the middle of the image, upon the negative, is a black line, broken at two points. The author attributes the alternation of dark and light in this central line to the interference of the rays passing through the needle and those diffracted around its periphery. Applying the usual calculations for light waves to the data thus obtained, the wave length is found to be only 16 millionths of a millimetre.

Alternating-Current Machinery—XXII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

COMPOSITE E. M. F. S.

185. We have hitherto considered circuits in which sinusoidal currents flow under the action of sinusoidal E. M. Fs., or composite circuits, in which both continuous and sinusoidal E. M. Fs. are simultaneously active. We may now consider an alternating-current circuit in which any periodically alternating E. M. F. is induced. With the exception of the influences introduced by the presence of iron cores in the various magnetic circuits, which are best considered separately, this generalized condition corresponds to the actual case of alternating-current circuits as employed in practice.

186. We have seen (Sec. 182) that if two sinusoidal E. M. Fs. of different frequencies are connected in series so as to act simultaneously on a circuit; as, for example, when two separate alternators of different frequencies are coupled upon a common shaft, and with their armatures connected in series, each alternators will send a current through the circuit as though the other E. M. F. were absent, and the effective value of the total E. M. F. and total resulting current will have values which are readily determined when the separate values of the component E. M. Fs. and currents are known. Thus, suppose that a sinusoidal alternator of 30 ~ be connected in series with a second sinusoidal alternator at a different frequency, say, 60 ~ the resulting E. M. F. will have a graphical wave form, which will be the graphical superposition of the two component E. M. Fs. The form will evidently depend upon the magnitude of the two components and upon their phase relation. As the simplest case, we may suppose the alternators to produce the same magnitude of E. M. F., say, 100 volts maximum, and that they are rigidly coupled to a common driving shaft, so that the two E. M. Fs. start positively from zero at the came instant, or when $t = 0$. We have, then, as represented in Fig. 129, a pair of alternators, A and B, with their armatures coupled on a common shaft, $s\,s$, and each supplying a sinusoidal E. M. F., whose maximum value is 100 volts, and whose effective value is, therefore, $\frac{100}{\sqrt{2}} = 70.7$ volts. Since the alternator B has twice the number of poles in its field frame as the alternator A, the frequency of its E. M. F. will be twice as great. If the armatures each make 900 r. p. m., the number of poles passed in one minute by a point on the armature will be $4 \times 900 = 3600$ in A, and $8 \times 900 = 7200$ in B. This represents 1800 cycles per minute, or 30 cycles per second, in A, and 3600 cycles per minute, or 60 cycles per second in B. The E. M. F. between the terminals a, a', of A, will, therefore, be

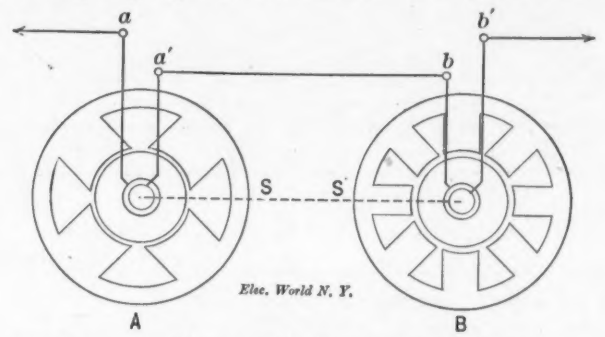


FIG. 129.—ALTERNATORS CONNECTED IN SERIES.

$$e_a = 100 \sin 30 \times 2\pi t \text{ volts}$$

and between the terminals b, b', of B, the E. M. F. will be

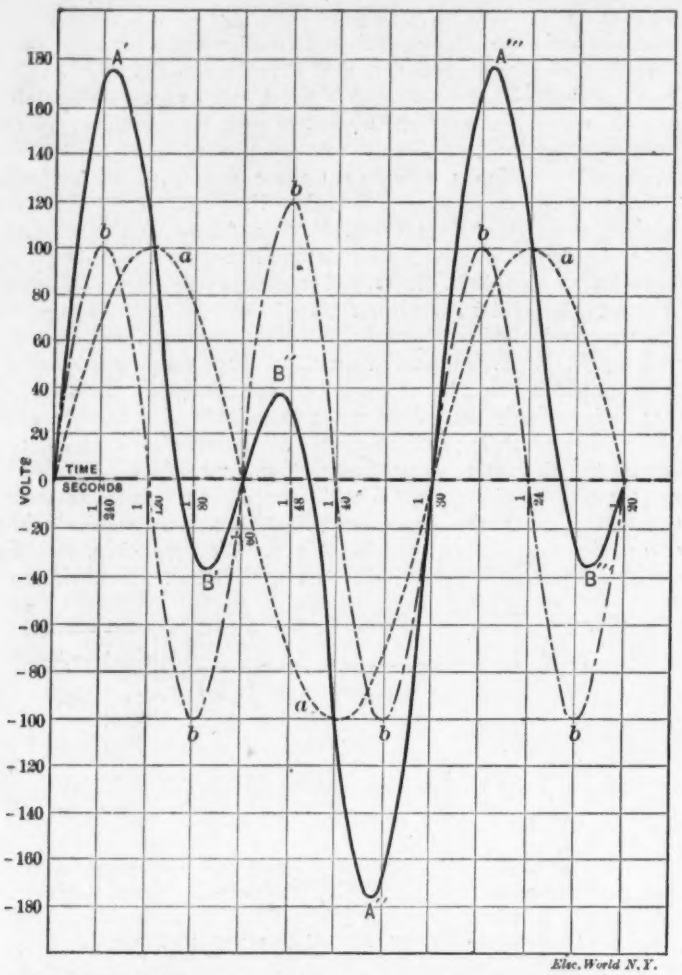
$$e_b = 100 \sin 60 \times 2\pi t \text{ volts.}$$

The total E. M. F. between the extreme terminals a and b', will be $e = e_a + e_b$ volts, and the effective value of this E. M. F., or the amount shown by the voltmeter between the extreme terminals will be

$$E = \sqrt{e_a^2 + e_b^2} = \sqrt{(70.7)^2 + (70.7)^2} = 100 \text{ volts.}$$

The resultant E. M. F. e is represented graphically in Fig. 130, where the dotted sinusoidal curves a and b represent the component E. M. Fs. of 100 volts' amplitude, and where the heavy unbroken curve $A\,B$ represents the resultant E. M. F. e, their superposition or sum. It is evident that the resultant e is not a sinusoidal E. M. F. It is, however periodic, and repeats itself cyclically in each 1/30th of a second; or, in other words, has a frequency of 30 ~ equal to the frequency of the low frequency component e_a. It will also be evident that, although the resultant e is an alternating E. M. F., it is

not a symmetrically alternating E. M. F. (Sec. 9); for, considering the first cycle, the first positive wave A' has a maximum value of 176 volts, while the succeeding negative wave B' has a maximum of only —38 volts. The next positive wave B'' has a maximum of 38 volts, while the next negative wave A'' has a maximum of —176 volts, and so on. This dissymmetry in the resultant E. M. F. would exist whatever the relative magnitude of the sinusoidal components, and whatever their relative phase at the epoch of starting; that is to say, the dissymmetry is an essential property of the superposition of two sinusoidal waves, one of which has double the frequency of the



Elec. World N.Y.

Fig. 130.—Combination in Series of Two Sinusoidal E.M.F.s of Equal Magnitude, One Having Twice the Frequency of the Other.

other. It would be found in the same way that if we connect in series two sinusoidal E. M. Fs., one of which has four times, or six times, or any number of times the frequency of the other, the resultant combined E. M. F. will be dissymmetrical, whatever may be the phase or amplitude of the components.

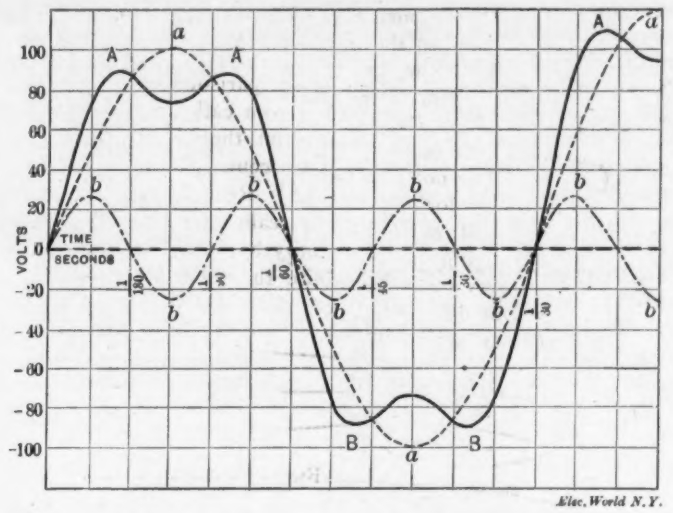
187. When a sinusoidal E. M. F. e_a of given frequency is connected in circuit with one or more sinusoidal E. M. F.'s e_b e_c. e_d. etc., whose frequencies are exact multiples of the first frequency, e, it is said to be the *fundamental; i. e.*, the lowest, while the others are said to be its *harmonics*. Thus, in Fig. 130, the sinusoidal E. M. F e_a of frequency 30 ~ is the fundamental E. M. F. in the diagram, and the sinusoidal E. M. F. e_b of frequency 60 ~ is its first harmonic, or its harmonic of double frequency. These terms have been adopted from the science of acoustics, by analogy to the case presented of a composite tone, which is known to consist of a fundamental pure tone, having the lowest pitch present, and an associated number of superimposed harmonious pure notes, each having a frequency which is some multiple of the fundamental frequency.

188. It is, therefore, evident from what has been said concerning Fig. 130, that the effect of superimposing upon a fundamental E. M. F. a harmonic of a frequency which is an even multiple of the fundamental frequency, *i. e.*, an even harmonic, is to produce a dissymmetrical alternating E. M. F.

189. If the alternator B, in Fig. 129, had twelve poles instead of eight, it would produce a frequency three times as great as the alternator A. If we suppose that the armatures are so coupled that the two E. M. Fs. start positively at the epoch when $t = o$, and also that the E. M. F. generated by B has an amplitude of 25 volts, or one-quarter the amplitude of A, the resultant E. M. F. is

$$e = e_a + e_3 = 100 \sin 30 \times 2\pi t + 25 \sin 90 \times 2\pi t \text{ volts.}$$

Fig. 131 shows the type of alternating pressure wave obtained by such a connection. The dotted line a is a sinusoid of period 1/30 second, or a frequency of 30 ~and 100 volts' amplitude; while the dotted line b is a sinusoid of period 1-90 second, or of frequency 90 ~ and 25 volts' amplitude. The heavy unbroken line $A\,A\,B\,B$ shows the com-



Elec. World N.Y.

Fig. 131.—Combination of a Single Alternating EMF with Its Triple Frequency Harmonic.

bined E. M. F. of 89 volts maximum. This curve represents a periodic E. M. F. of frequency 30 ~ or of the same frequency as the fundamental a, and has also a symmetrical alternating E. M. F., since the negative wave $B\,B$ is the production of the positive wave $A\,A$, but with the reverse sign.

190. By combining any sinusoidal E. M. F. with a sinusoidal E. M. F. of triple, quintuple, septuple, or any odd frequency, we should find, in the same manner, that the resultant E. M. F. was a symmetrical-alternating E. M. F., no matter what the relative phase and amplitude of the two components. We therefore arrive at the general rule that any combination of a fundamental sinusoidal wave of current, or pressure, with any one or more odd frequency harmonics produces a symmetrical-alternating wave, whatever may be the relative magnitude of the components, or whatever their phase relations.

The Consolidation of the Wire Manufacturers.

Among the concerns involved in the consolidation of iron and copper wire manufacturers under the management of J. P. Morgan & Co. are the following houses, whose products are largely used in the electrical arts: The Washburn & Moen Manufacturing Company, Worcester, Mass.; the American Electrical Works, Providence, R. I.; John A. Roebling's Sons Company, Trenton, N. J.; Ansonia Brass & Copper Company, Ansonia, Conn.; Bridgeport Brass Company, Bridgeport, Conn.; Benedict & Burnham Manufacturing Company, Waterbury, Conn.; the Coe Brass Manufacturing Company, Ansonia, Conn.; Taunton Copper Manufacturing Company, Taunton, Mass. A conference of the representatives of these and other houses was held in New York on December 9, to settle upon the details of consolidation. It is reported that the new corporation will be named the American Steel & Wire Company, and will have a capital stock of $70,000,000. This consolidation differs from that proposed of the insulated wire manufacturers, which has been noticed in these columns.

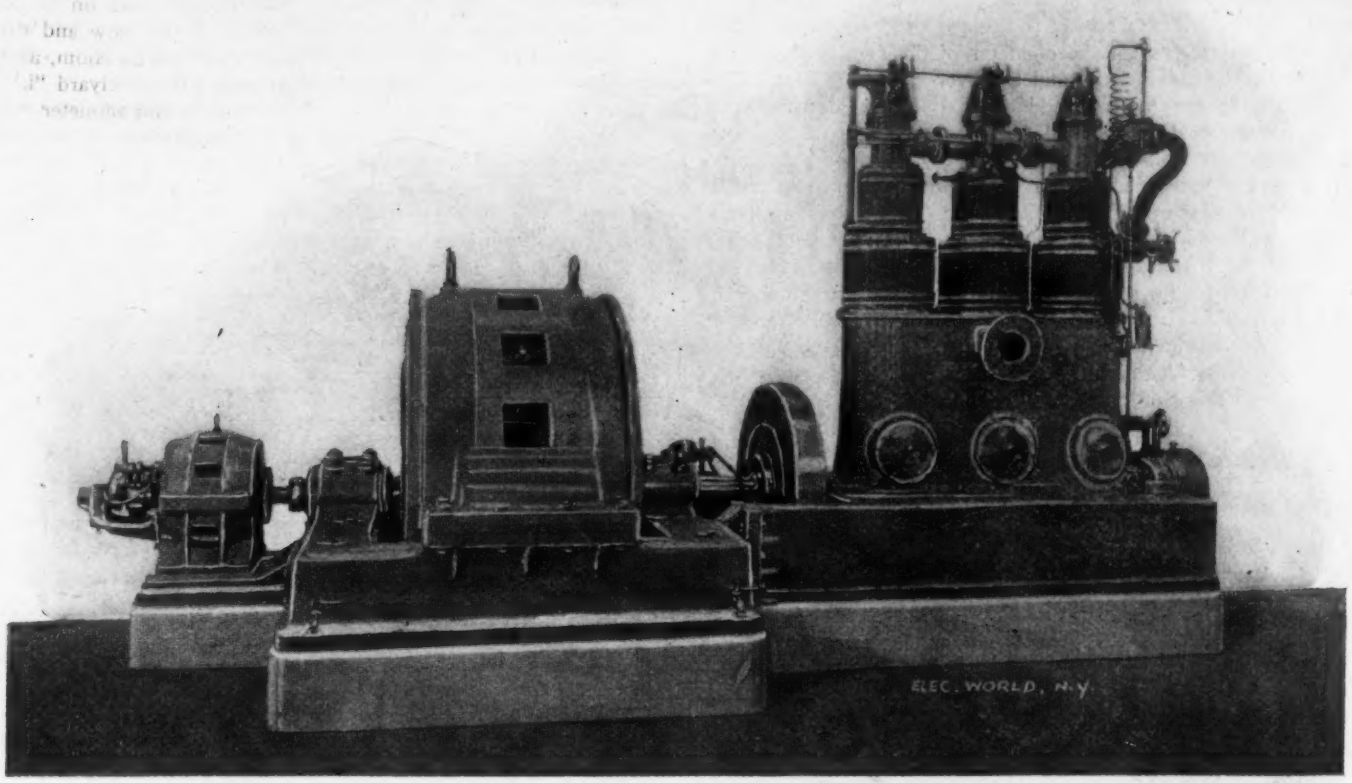
Iceland as a New Country to Conquer.

Our Paris contemporary *L'Industrie Electrique* calls attention to the numerous water powers in Iceland, which are estimated as capable of developing a milliard horse-power, although this may be somewhat exaggerated; furthermore the volcanic rocks are very rich in useful minerals. With the facilities offered by the use of electricity, it is thought that there may be quite a future for that country.

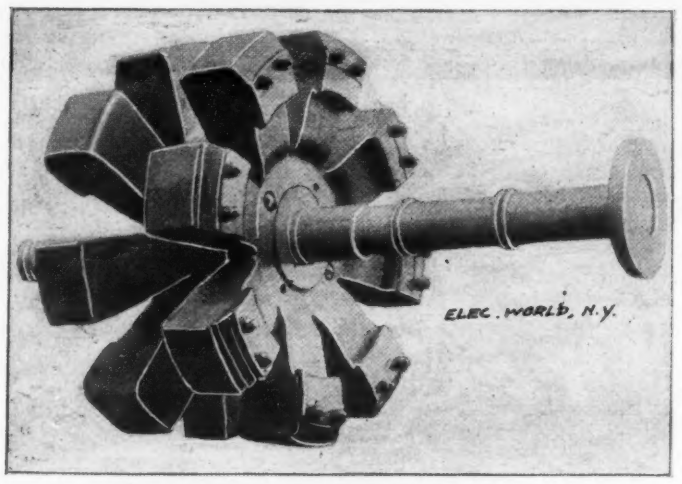
Torquay Electric Supply Plant.*

Through the courtesy of Messrs. Easton, Anderson & Goolden and Messrs. Willans & Robinson we visited the new and extensive works of the last-named firm at Rugby, last week, in order to be present at a trial of the first of three steam alternators now being constructed for the electric supply station at Torquay. We found the set ready for trial on a steam bed in the spacious electric light and power house belonging to Messrs. Willans & Robinson's works. Before describing the tests to which the set was subjected, however, we may first describe the details of its construction.

The generating set, as shown in the accompanying illustration, consists of a 125-kw Fynn alternator, built by Messrs. Easton, Anderson & Goolden, direct-coupled to a 225-indicated hp Willans engine, of the 3-H-S. type. It is designed to run at about 375 revolutions per minute, with steam at 130 pounds pressure, and to develop 62.5 amperes at from 2000 to 2200 volts on the terminals, the frequency of alternation being 50 cycles per second.

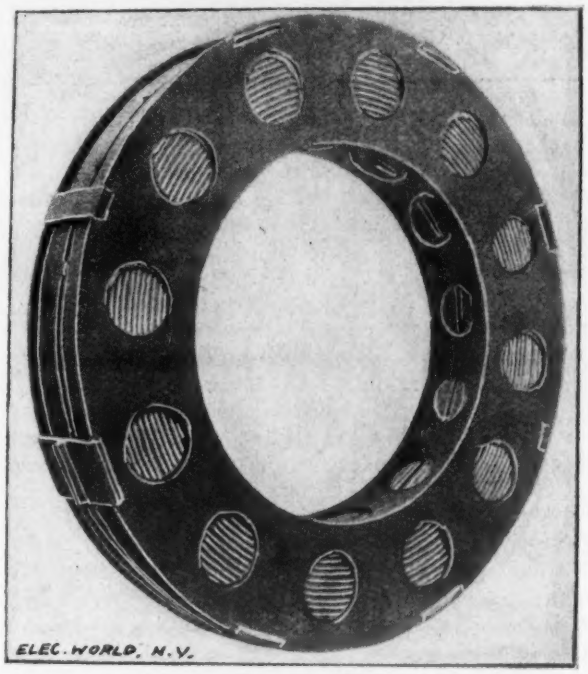


WILLANS ENGINE, FYNN ALTERNATOR AND EXCITER.



ROTOR OF FYNN ALTERNATOR.

Describing first the electrical side of the set—the alternator is constructed according to the designs of Mr. V. A. Fynn and exhibits several features of interest. It consists of an outer fixed circle of armature coils, an inner fixed exciting coil, and a set of revolving magnets. The figures clearly show the general construction of these parts, and are taken from photographs of the actual machinery. Within the armature which forms the outer frame of the machine the magnet coil is supported by brackets, this coil being an annulus occupying the central part of the width of the armature. The main bearings of the generator carry a shaft upon which are mounted the magnet core and two circles of magnet poles, the poles on one circle being displaced so as to be opposite the polar gaps of the other circle, as shown. In the completed machine the space between the two sets of poles is occupied by the annular field coil, there being ample clearance at all the surfaces, and thus the one set of poles is maintained at *N* polarity, the other set being always of *S* polarity. The effect of this disposition of the poles is to produce a



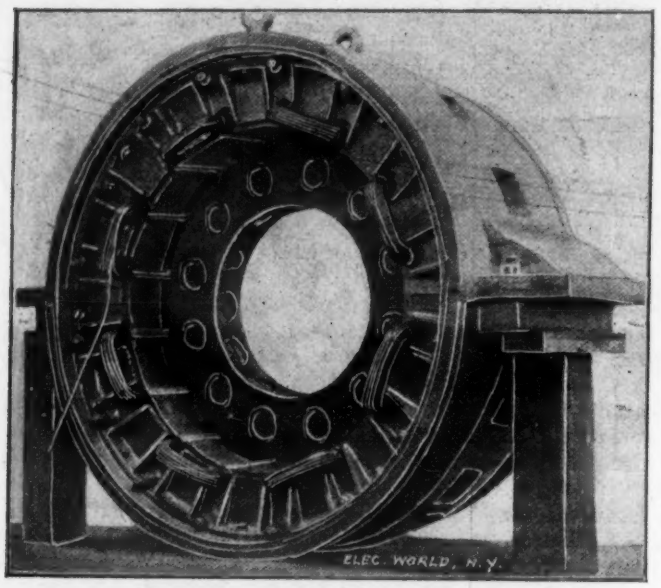
FIELD EXCITING COIL.

* Reprint from the *Electrician* (London), November 26, 1897.

complete reversal of the magnetic flux through the armature coil in each cycle of alternation, while at the same time the magnetic flux in the iron at any part is never reversed, but fluctuates no more than from zero to a given maximum. This, as will be readily seen, is brought about by the fact that, through the "staggering" of the poles, poles of opposite polarity come alternately immediately opposite any given coil, while, on the other hand, poles of opposite polarity never pass in front of the same part of the iron core of the armature.

In the Torquay alternator the diameter of the armature is 4 feet 6 inches inside the polar circle, and the over-all width is 40 inches. There are eight armature coils and eight poles on each field-pole circle, or sixteen field poles in all. The armature has a resistance of 0.261 ohm at 120° F., and is wound with 61/20 stranded double-cotton-covered and braided copper cable, shellac varnished. The coils are laid in ⅛-inch paper tubes, tested to 12,000 volts, and laid in slots between the laminations. The resistance of the field coil is 1.39 ohm at 125° F., the coil being wound with double cotton-covered and varnished solid round copper.

The Willans engine to which this alternator is coupled is a three-crank compound condensing engine, having a stroke of 8 inches, and with cylinders of 17 inches and 12 inches diameter. It is fitted



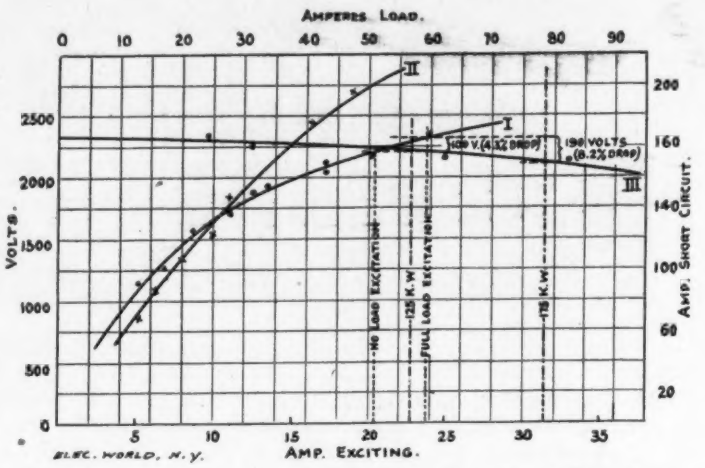
Stationary Armature and Field Coils.

with Messrs. Willans & Robinson's steam-controlled automatic expansion gear. The engine is designed to run on steam at 130 pounds pressure, and, with a vacuum of 26 inches, and at a speed of 375 revolutions, it will readily deliver 200 belt horse-power to the alternator.

Coming now to the tests which took place last week: The first test to be undertaken was to run the set for six hours at full load, and to take frequent readings of the input of steam and output of electrical energy, with a view to determine the efficiency. Subsequently a temperature test was made in order to determine the rise of temperature of various parts at the end of the six hours' trial. The set was also subjected to a test of its performance at half load. On entering the machinery room the first impression we gained was that for an alternator the machine ran remarkably quietly. We found it impossible to distinguish the moment when the full load was cut off by stopping the excitation, and even when the set ran at a considerable overload the moment of cutting off load was only detectable through a transient increase in speed. Such small noise as the alternator does make appears to be due more to the ample ventilation than to any magnetic effect.

Messrs. Willans & Robinson's works stand in the first place in regard to the splendid, almost luxurious arrangements of their testing department. Standing beside the recording table, one sees in front of one the steelyards of the weiging tanks for the steam measurements; while to the left are the transparent scales of reflecting ammeter and voltmeter instruments, the instruments themselves, together with standards of resistance and E. M. F., and means for ready calibration, being contained in an adjoining dark room. Outside are the weighing tanks, into which the condensed steam pours in a robust stream that is more eloquent than a professor's lecture; and beyond the tanks are the generating set and the condensers, while farther away, upon one of the walls, is an immense standard non-inductive resistance of manganese steel strip in series with a water resistance, the manganese steel strip acting ac a potentiometer, the voltage on which is perpetually shown on one of the transparent screens in the testing room. Every now and then an electric bell rings beside the operator in the testing room, as a prearranged weight of condensed steam makes the steelyard "kick the beam." The time is duly noted, the voltmeter and ammeter readings are entered, and signals are passed to the engine attendant to quicken or reduce speed, etc., as may be necessary.

We have not space to enter fully into detail in our description of the tests. The six hours' trial at full load showed that the set practically complied with the guaranteed efficiency and steam consumption; and equally satisfactory results were obtained with the trials at half load and at an overload. As regards the temperature of the alternator, the armature coils rose 24° F., the iron rose 15° F., and the magnet coils rose 15° F., figures all well within the guaranteed limits. Further data of tests made on this alternator are shown by the curves below. We may add that the excitation for the full



I.—Saturation Curve at 375 Revolutions. II.—Short Circuit Curve. III.—Load Curve—Excitation at Full Load. 675 Watts.

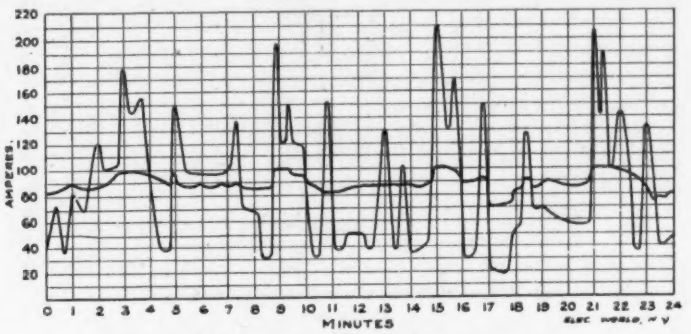
load trial last week was 675 watts, or 0.5 per cent. of the full rated output. The excitation is about 19 per cent. less at no load, running at the same speed and volts. It is of further interest to state that the alternator withstood a short circuit test made by bridging he terminals with a short length of No. 16 B. W. G. copper wire, the current rising to 160 amperes.

Torquay electric supply station is arranged more for hard work than for show, as it is situated within a number of inartistic and unassuming arches or cellars. The equipment contemplated for the outset of operations comprises three generating sets of the size and type described above. Steam for these is generated in a battery of Babcock-Wilcox boilers. The feed pumps, supplied by Messrs. Babcock & Wilcox, are of the Worthington duplex type, and are of ample capacity to supply all the feed water, with a reserve against the contingency of a breakdown. The engines are fitted with Ledward's ejector condensers. By means of these handy and compact condensers several advantages over older patterns are obtained, not the least of which is that the vacuum is produced close to the place where it is most wanted, viz., beside the engine. Each separate low-pressure cylinder may have its own separate ejector condenser mounted beside the cylinder. The effect of this method of arranging the plant is to give a much better vacuum inside the cylinder, which is really the only place where a vacuum is required.

The station will principally supply current for arc and glow lighting, but in anticipation of a certain demand for electric motive power the frequency of the alternations has been fixed at 50 cycles. For the street arc lamps—an almost indispensable item at a seaside resort—Ferranti rectifiers will be used, it being intended to erect three rectifiers, of which one will serve as a stand-by.

Accumulators in Electric Railway Power Stations.*

The Zurich-Hirslanden electric tramway line was opened in 1894. The length of the line is about three miles, the profile being quite irregular, with a maximum grade of 6.5 per cent., 135 yards in length. Sixteen small cars are used, the weight without passengers being about 5½ tons each. Each car is equipped with one 20-hp motor, built by the Oerlikon Works. The power station contains two vertical compound engines of 100 horse-power each, belted to 60-kw shunt dynamos. The storage battery consists of 270 cells, which are connected simply in shunt with the shunt dynamo and the load, there being no booster whatever used. This arrangement has given good satisfaction, the only fault being the variation of line

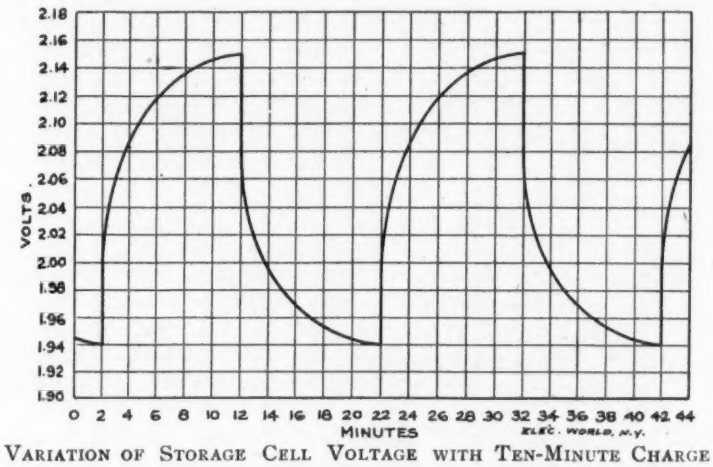


CURVES OF DYNAMO AND LINE CURRENTS.

voltage which is noticeable in the car lights, since there is no possibility of over-compounding with such a system as that described.

The two curves in the accompanying illustrations show the fluctuation from minute to minute of the current consumption of the line, and the far smaller fluctuation of the current generated by the dynamo, the difference, of course, being made up at every instant by the storage battery. The line current varies between limits of 20 and 210 amperes, the dynamo current being held by the battery between the extreme limits of 72 and 102 amperes. The voltage varies between 535 and 560 volts.

The exact behavior of the storage cells themselves in this service is extremely interesting. In the accompanying line cut may be found a diagram of the voltage variation of the individual cell, with a reversal of a given current from charging to discharging, and vice versa. In the diagram, the horizontal divisions of which represent



VARIATION OF STORAGE CELL VOLTAGE WITH TEN-MINUTE CHARGE AND DISCHARGE,

time, and the vertical divisions the voltage of the cell, the charging current was abruptly started at the two-minute point, followed by reversals every ten minutes, the current strength remaining constant. The immediate effect of a reversal form discharging to charging current may be seen in the instantaneous rise of voltage, about .06 or .07 of a volt in this particular instance—this value differing, of course, with currents of different intensities—after which the voltage gradnally rises about .14 or .15 more. The first abrupt change is caused by the drop due to internal resistance, and is proportional to the current times the resistance of the battery. In this particular case it is really equal to twice the current times the internal resistance, owing to the fact that the current is reversed, the drop being additive to the battery voltage when charging and subtractive when discharging. The further and more gradual rise is due apparently to a sort of polarization, the curve rounding off to a practically horizontal direction, which it maintains if the current is continued until the battery is fully charged. In this particular test, however, after ten minutes of charging, the curve having practically reached a horizontal direction, the charging was stopped and an equal discharging current suddenly drawn from the battery. At this instant there appears again the immediate drop due to the internal resistance, now diminishing instead of increasing the battery voltage, followed by the gradually decreasing further drop due to other causes.

From this curve it may be seen that if the battery were continuously charged to full load at the current strength applied in this test, and then continuously discharged at the same current strength, there would be approximately .2 of a volt or 10 per cent. difference between the charging and discharging pressures, which would mean just 10 per cent. loss over and above the losses due to the ampere-hours output being less than the ampere-hours input. But with loads which vary between wide limits in a few seconds or even a few minutes time, such as those of street railway systems, the battery does not get time for the polarization effect and holds its voltage much more steadily, and therefore gives a better service than might be expected, considering its charging and discharging curves alone. Further, as the drop in such rapidly oscillating street railway loads is mainly due to the internal resistance, the reduction of the latter is of great importance in batteries intended for such work. The battery in use on this line has been in constant service for two and one-half years, no signs of depreciation having as yet appeared.

Another plant, namely, that used in the operation of the Remscheid line, is also interesting. This line was put into use in 1892, and has at present a length of about 7 miles, on which are many grades, only a very short part of the line being level. The maximum

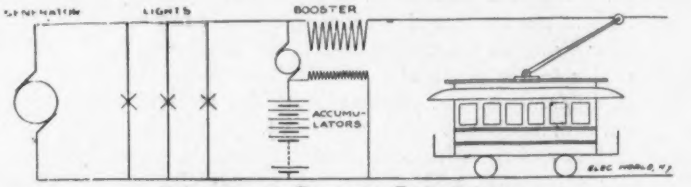


DIAGRAM OF BOOSTER CONNECTIONS.

grade is over 10 per cent. Motors for general factory driving are supplied from the same line, thereby steadying the load somewhat. Four 100-kw dynamos were in use at the time the battery was installed, these dynamos being no more than sufficient to carry the maximum loads. With the battery in service two dynamos supply all the current, the cost of the battery being less than half that of the generating machinery which it displaced. The battery consists of 250 Tudor cells, with a capacity of 648 ampere hours at a discharge rate of 216 amperes, the maximum allowable rate of discharge being about 420 amperes. The connections between the battery and the rest of the system are on the Siemens & Halske compensating plan. which is shown diagrammatically in the accompanying drawing. The generator supplies both a lighting circuit and the railroad system, the feeder to one side of the railroad circuit being carried through a field coil of the battery booster, which is differentially wound, the shunt coil acting in opposition to the feeder series coil, and rendering the excitation zero with the normal railroad load. As the load rises above normal the series coil more than overcomes the shunt coil and builds up a voltage in the armature (which is constantly running), tending to help the storage batteries to discharge. If the railroad load falls, on the other hand, below the normal, the shunt winding on the booster fields more than overcomes the series winding, and causes the booster to generate a voltage in opposition to that of the battery, and therefore tending to charge it. The booster is so adjusted that the battery voltage is raised or lowered just sufficient to take up the fluctuations of the current demand, and render the load on the generating system constant, thereby enabling the generating dynamo to maintain a constant pressure at the lamps.

In the booster used at Remscheid the compounding is not effected directly on the fields of the booster, but is accomplished on the fields of a small exciter, the armature of which generates a current for the booster fields. The booster and its exciter are driven by a 90-hp motor. The booster is used only in the evening when the lighting system is in use, in order to obtain as close regulation as possible. For the supply of the railroad alone the battery is connected in simple shunt, the booster being shut down, the voltage variation in this case being no more than fifteen volts. The saving of coal due to the addition of the accumulators to this system is estimated at 11 tons per week.

* Abstract of a communication by Ludwig Schroeder to the Elektro-Technischer Verein, and reprinted in *L'Eclairage Electrique.*

Some Experiments on Induction with Currents of High Frequency at Long Distance—I.*

BY EDWIN F. NORTHRUP, GEO. W. PIERCE AND FRITZ REICHMANN.

No one is particularly impressed on seeing a bell ring when pulled by a string. One which responds, on the other hand, to pressure on a distant button seldom fails on contemplation to excite some wonderment, but when everything sensible—strings, wires and even air—are absent, and molar masses are seen to acquire motion through influences acting at a great distance, even though the motions of the ethereal medium may be known, and the phenomena subjected to calculation which may forecast them, the thinking mind is deeply impressed and often startled by the actions manifested. To observe the phenomena which suitable experiments can elicit from this recently recognized ether must ever be a source of pure delight to a rightly constituted mind. It was our pleasure to spend a portion of the past summer in performing some experiments which, though employing only well-known principles, and leading perhaps to nothing novel, yet show something of the subtle action of the ether and bring forcibly to mind the importance and power of resonance in electrical circuits. The interest which we ourselves felt in the experiments leads us to believe that scientific readers may not feel indisposed to read an account of a repetition of phenomena trite, perhaps, to students of electrical science.

The first thing to consider, when observations are to be made upon ether disturbances produced by oscillating currents of high frequency, is a suitable detector. Since an instrument capable of quantitative measurements is to be preferred, spark gaps, telephones, coherers, vacuum tubes and the like were discarded, and an extremely delicate instrument was constructed after a form first used, we believe, by Fleming. The construction of this instrument is based upon the principle that when a disc of conducting metal is suspended obliquely in a coil carrying an alternating current the disc tends to set itself at right angles to the plane of the coil. Two such instruments were made, of different size and external form. The first and larger of these is shown, with its dimensions, in diagram I.

The delicacy of these instruments was due to the use of fine quartz fibres for suspension, and rapid damping was obtained by placing the disc between the poles of a permanent magnet. Any motion of the disc generated currents in it which brought it back to rest. Some details regarding the construction of these instruments are worthy of note, since care and experience in these details can alone make the instrument delicate and serviceable. The deflections were read by means of a telescope and scale. The complete period of the first instrument was 16 seconds, and that of the second was 13½ seconds. In the first instrument the system consisted of a ring of pure silver, with an external diameter of 12 mm and an internal diameter of 7 mm, mounted upon a fine glass rod, which carried a thin, small mirror just above the coil. In the second instrument a silver disc 6 mm in diameter was used instead of a ring. The mirror in this instrument was 4 mm by 7 mm. Such mirrors can readily be made by silvering ordinary microscopic cover glass. They may be given the desired shape by breaking them in the following manner: The mirror is laid face down upon a hard, smooth surface; the edge of a steel rule is placed upon the silvered surface and pressure exerted, when the mirror breaks along the edge of the rule. Since cover glass is extremely thin, using varnish upon the back of the mirror, or mounting it directly with any kind of cement, will distort the glass and give a confused image of the scale. The mounting is best accomplished by first fastening with hot sealing wax a small strip of cover glass to the rod. The surface of this should then be touched with shellac, and the extreme upper edge only of the mirror laid upon it. The greater portion of the mirror is thus unstrained, and a clear scale can be obtained from an extremely light mirror. The coil of the instrument shown in the cut was wound in several layers upon a hard rubber bobbin with very thin walls. Waxed paper was placed between the layers, and the whole coil was soaked in hot beeswax and rosin. This precaution is required to prevent short circuits between the layers. At the top of the coil all the wires made a semi-circular turn, so as to leave a slot in one side of the coil, through which the glass rod bearing the silver

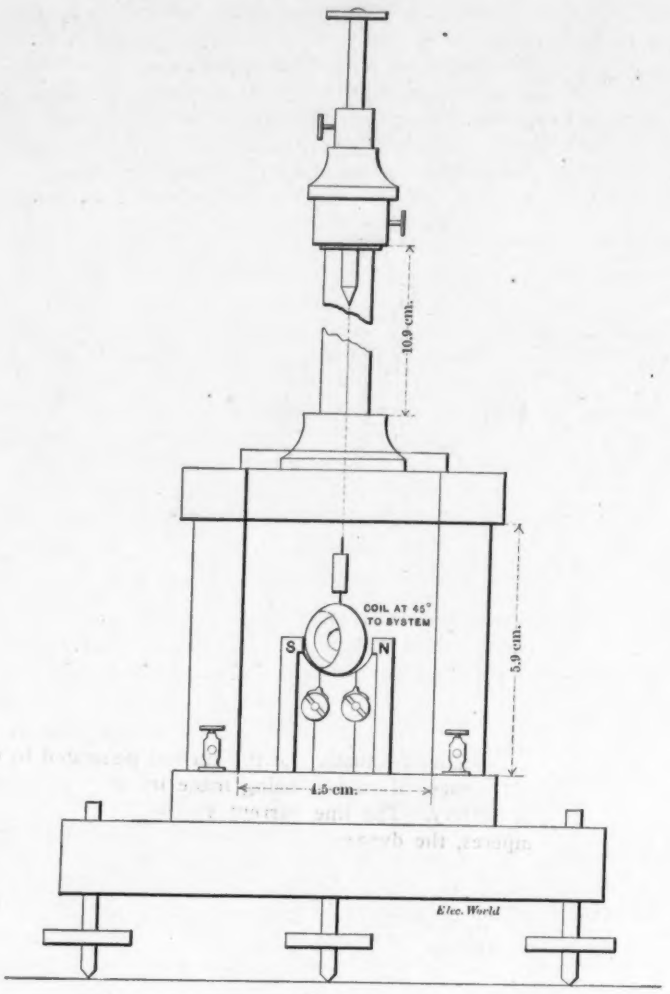


FIG. 1.

ring could pass, thus bringing the axis of rotation of the ring in the centre of the coil. This made the coils detachable. Various coils with different numbers of turns were tried. One which gave satisfactory results, when the frequency of the induced currents was comparatively low, contained 104 turns of No. 36 B. & S. wire. The

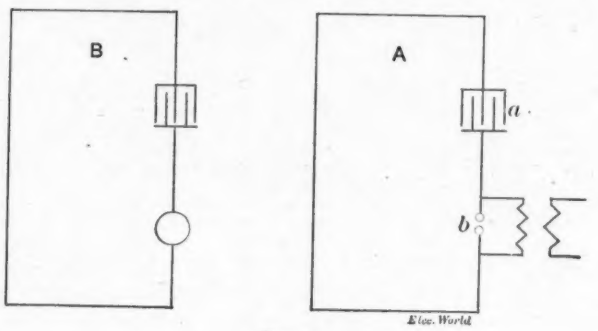


FIG. 2.

axial depth of the coil may be as great as, but not greater than, the axial distance from one edge to the other of the silver ring or disc, when placed in the coil at an angle of 45°. The ends of the quartz fibre were attached with hot sealing wax.

It is essential that the silver ring should not come in contact with iron, for since the ring is suspended between the poles of a magnet the attraction upon the ring due to the presence of iron may greatly decrease the sensitiveness of the instrument. On the other hand, the silver may be found dia-magnetic, in which case the system, when brought by the torsion of the fibre into the right position, may be found to be unstable. This difficulty may be overcome by brushing

* Since writing the above article an experiment to be made with an instrument of the character of the one above described has been suggested to me by a statement of Prof. J. Trowbridge. He has expressed the opinion that the discharge from a storage battery and perhaps other batteries is more or less oscillatory in character. Not having the means to try the experiment myself, I would suggest that some one construct an instrument like the above, but with heavy wire in the coil, and that the instrument be directly connected to a storage cell. On making or breaking the circuit there will, of course, be a large deflection, but if the current is absolutely steady, after a time the instrument should return again to the zero of open circuit. If the current is at all oscillatory the instrument should show a permanent deflection. I believe the point well worth testing.—EDWIN F. NORTHRUP.

the silver disc with a weak solution of iron sulphate. A few trials will serve to nullify the action of the magnet on the system.

When one of the instruments was first set up a curious and puzzling drift of the zero was observed. This was finally traced to the slow dissipation of a static charge which had been produced upon the inside of the case of the instrument by dusting it out with a camel's hair brush. Observations were made of this phenomenon, the cause of which at first was not understood. These observations are given below, as they show the extreme persistence of a static charge and the difficulty which may arise by its presence.

Time.	Scale reading (cm).	Remarks.
4:41 P. M.	36	Breathed in instrument previous to reading to dissipate charge.
5:00	34.3	.....
5:20	32.4	.....
5:50	30.2	.....
8:20	23.8	.....
11:06	20.1	.....
1:00 A. M.	18	.....
2:23	17.3	.....
8:45	14.1	.....
10:14	13.3	Again breathed in case.
11:05	12.8	.....
11:15	31	Readjusted zero to this reading
12:15 P. M.	31	.....

This table shows that the effect of the slow dissipation of a static charge had endured for seventeen hours and thirty-three minutes, and would probably have continued much longer had not its dissipation been hastened by the vapor of the breath.

A number of miscellaneous experiments not worth recording in full were made with this instrument previous to the observations which were conducted upon distant induction. It was found, for example, that high-frequency currents from a Tesla apparatus, either direct or

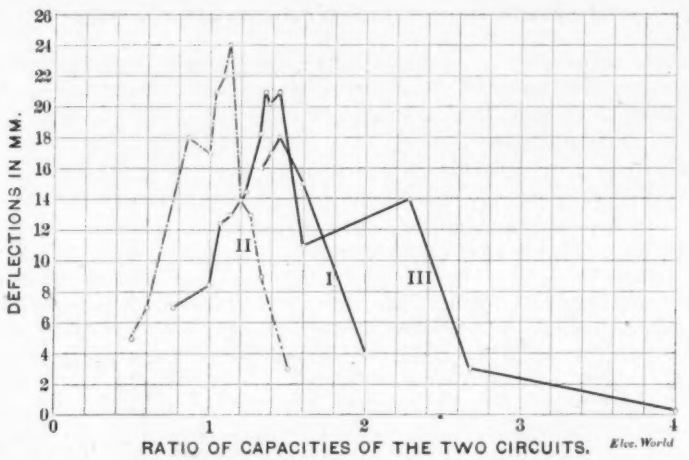


FIG. 3.

induced, would give large deflections; that an ordinary battery cell, upon being connected or disconnected through the coil of the instrument, would give large ballistic throws to the system. It was found that the inducing effect of slowly alternating currents, as those from the city circuit, was comparatively feeble. No limit was found to the frequency of currents which could be detected; an ordinary Hertzian oscillator inducing currents in a similar arrangement containing the instrument gave large deflections. The induction effects of oscillating currents were easily observed in the University building at a distance of 75 feet.

EXPERIMENTS SHOWING THE IMPORTANCE OF RESONANCE.

Two loops were strung up at a distance apart of 357 feet, one at University Hall, and the other at the main building of the University. When the circuits were in resonance, under the best conditions, a deflection was obtained of 120 mm.

In one series of experiments the inducing circuit at the hall (*A*, Diagram II.) consisted of a rectangular loop of bell wire, the dimensions of which could be varied. As it was necessary to use rapidly oscillating currents, a condenser of small and variable capacity and a spark gap were inserted in series in the loop (*a* and *b*, Diagram II.). The receiving circuit has a similar loop with a condenser in series with the instrument, which took the place of the spark gap. The condensers in both circuits were built up of tin foil and glass plates, 18 x 20 inches. Fractional values of the capacity of one pair of plates were obtained by folding back the upper tinfoil sheet a known amount. The spark gap consisted of two brass balls about 2 cm. in diameter, their separation being effected by means of a micrometer screw.

In experiments upon induction of this kind it is important that energy should be supplied to the inducing circuit continuously during the period that the system of the recording instrument in the receiving circuit is deflecting. Since an induction coil or influence machine only supplies energy at intervals long separated compared with the actual duration of a discharge, it is evident that to obtain the best effects a source of current should be employed which will give a continuous discharge across the spark gap. It is further necessary, in order that oscillations may occur in the circuit, that the discharge shall not have the character of an arc. These conditions were very well fulfilled by raising the potential of the alternating 100-volt city circuit by means of a high-potential transformer. The terminals of the secondary were directly connected to the opposite sides of the spark gap, and the primary to the city circuit terminals, through a variable inductive resistance. A foot bellows provided a strong blast of air, which continually played between the balls. Without this air blast to blow out the arc only very feeble oscillations will occur, and practically no induction effects can be obtained, but with it the oscillations are strong and continuous. With this arrangement it is entirely unnecessary to have the balls kept bright or polished. Furthermore, the effects obtained can be made extremely uniform if a condenser is inserted in series with the secondary of the coil, of such a capacity that the arc between the balls ceases to have a flaming character. This condenser becomes unnecessary if the capacity in the inducing circuit is large.

To obtain any observable induction effects between small loops of a single turn at the distance at which we worked the two conditions must be fulfilled that the current in the inducing circuit shall be very rapidly alternating, and that the two circuits shall be electrically tuned or synchronized. The necessity of the first condition was proved by short circuiting the condensers in the two circuits, and then passing currents of ten or fifteen amperes from the alternating city circuit around the inducing loop. The instrument in this case gave no deflection. To prove the imperativeness of the second condition in obtaining distant induction effects was the object of the experiments, and the results of the observation made are given below:

With two circuits of rectangular loops at a distance apart of 109 meters, the inducing loop being 14 m. by 9.4 m., and the receiving loop 14 m. by 8.4 m., the larger instrument containing a coil of 104 turns of No. 36 B. & S. wire being used, the following average deflections were obtained:

TABLE I.

N_1 = No. of Plates in Inducing Circuit	N_2 = No. of Plates in Receiving Circuit.	Ratio of the Capacities in the Two Circuits $= \frac{N_1 - 1}{N_2 - 1}$.	Deflection in mm.	Plotted in
3	2½	1.33	16	Curve I.
	2 7-16	1.39	17	
	2⅜	1.45	18	
	2¼	1.60	15	
	2	2.00	4	
4	3	1.50	3	Curve II.
	3⅛	1.33	9	
	3⅛	1 26	13	
	3½	1.20	14	
	3⅝	1.13	24	
	3¾	1.09	22	
	3⅞	1.04	21	
	4	1.00	17	
	4½	.86	18	
	5	.75	13	
	6	.60	7	
	7	.30	5	
5	2	4.00	.3	Curve III.
	2½	2.67	3.	
	2¾	2.29	14.	
	3½	1.60	11.	
	3¾	1.45	21.	
	3⅞	1.38	20 2	
	3 15-16	1.36	21.	
	4	1 33	18.2	
	4¼	1.23	14.5	
	4½	1.14	13.	
	4¾	1.07	12.5	
	5	1.00	8.6	
	5¼	.76	7.	

These readings are plotted as Curves I., II. and III., Diagram III. The deflections, as will be shown later, are approximately proportional to the square of the current through the coil, these curves serving to show how the observable induction effect increases as resonance is approached.

The Need of Precise Electrical Nomenclature.

To the Editor of The Electrical World:

Sir—I notice in your issue of December 11 an editorial on the various terms used in describing transformers of different sorts. I particularly agree with your objection to the use of the expression "static transformer." The word static, in the electrical art, has acquired a certain techincal meaning, and is always used with reference to a certain class of phenomena. Now, there exists a class of alternating converters working, or alleged to work, by virtue of a condenser action. It is possible that this term might be applied to such devices, but it has certainly no relation to the ordinary alternating transformers, consisting of one or more iron cores with primary and secondary windings.

The Patent Office divides transformers into "stationary" and "rotary," and the terms seem to me to be well selected. But the office uses the term "rotary transformer" a little too broadly, it seems to me, as including any form in which one of the parts rotates, or in which all parts are stationary, and the resultant magnetic field rotates, as in the inducing member of a multiphase motor.

A sub-class includes motor generators, etc., properly enough, but also includes the Dolivo-Dobrowolsky instrument, in which stationary coils, excited by multiphase currents, generate a rotary field in stationary cores.

It seems to me that the term "rotary transformer" should cover all forms in which any mechanical rotation, of iron or of copper, or of both, exists. The term "stationary transformer" includes, or should include, all forms in which there is no mechanical rotation.

The expression "motor dynamo" is bad, in view of the modern use of the word "dynamo." "Motor generator" is a good term to cover two machines on one shaft acting to transform direct to direct, direct to alternating, or vice versa, alternating of one frequency to alternating of another frequency, single phase to multiphase, etc.

There is no term at present, which is properly used to indicate the great modern instrument, the rotary converter with a single winding, changing alternating (usually mutiphase) to continuous. Such a term is badly needed.

Albert Gould Davis.

Washington, D. C.

The Three-Phase Railway Up the Gorner Grat.

The first trial trips on the electric railway up the Gorner Grat, near Zermatt, were carried out recently in the presence of the inspectors of the Swiss Railway Department. The section already completed has a length of 1600 metres and a gradient of 12 per cent.

The tests gave complete satisfaction, both the ascent and descent of this gradient being effected without the slightest difficulty, the motors holding the locomotive perfectly to its proper speed. Starting on the maximum gradient, with a fully loaded train, was also effected with ease.

It will be remembered that this is a rack railway, the total length being 9.8 kilometres and the maximum gradient 20 per cent. The power is derived from the Findelenbach, which drives four turbines of 250 horse-power each, coupled directly to three-phase alternators of 5000 volts and 40 cycles per second. Transformers are placed in the power house itself for feeding the line as it passes the building, and two other transformer stations are provided. The voltage on the trolley line is 550 volts. Each locomotive is equipped with two three-phase motors of 90 horse-power each, driving the main wheels by spur gear. Owing to the property of the three-phase motors by which they will act as generators, and take up the full power which they are designed to give out as motors, when driven at 2 or 3 per cent. above the speed of synchronism, the locomotive will, in descending, give power back to the line. In case only descending trains should be on the line, the surplus power will be taken up in a water resistance in the power house.

The contractors for the whole of the electrical equipment are Messrs. Brown, Boveri & Co., who, in the well-known Lugano tramway, were the first to apply the three-phase system directly to traction. They have also supplied the electrical parts of the locomotive for the Jungfrau railway, where their system is to be adopted, and are now engaged on the equipment of the line from Stansstaad to Engelberg, which is to be running next spring.

The standard gauge line from Burgdorf to Thun, in Canton Bern, is also to be equipped by them on the three-phase system, the power being taken from the power station on the Kander.

A Large Electric Road Project in Utah.

An electric road, 82 miles in length, is to be built between Ogden, Salt Lake City and Provo, Utah. The distance from Ogden to Salt Lake City is 37 miles, and from there to Prove 45 miles. The road is to be built by the Utah American and Foreign Development Company, of London, which company has undertaken the development of a large section of the country tributary to the proposed road. The district through which the road will run is said to be very rich, both agriculturally and in the line of mineral resources. The road will reach Provo canyon, which forms the only natural outlet for railroads in that direction, and it is expected that steam railroad extensions will be built, the traffic being handled electrically over the 80 miles of the company's lines. There are said to be extensive coal and iron deposits, which will be worked by the development company, with power derived from the same system as that for the railroad. The grades of the road do not exceed at any point 50 feet to the mile, and there is no occasion for sharp curves. The road will be laid down double track, with 90-pound steel rails and an overhead conducting system. The power house will be located between Salt Lake City and Provo, and 3 miles from the former, the maximum distance between the power plant and either end of the line being 42 miles. The plant is designed for 20,000 horse-power; and eight cross compound engines of 1500 horse-power each are to be installed at the start. The engines will be built by Robert Wetherill & Co., Chester, Pa. Direct coupled to the engines will be Stanley alternating dynamos of 750-kw capacity, the currents from which will be stepped up in stationary transformers to the line voltage. The company has also a plan for the utilization of Shoshone Falls, Idaho. There is available at these falls on the Snake River some 50,000 kilowatts of power continuously.

The General Electric and Westinghouse Compact.

It is stated that the arrangement between the Westinghouse Electric & Manufacturing Company and the General Electric Company, which has been in operation during the past year, is not producing the results that were expected of it at the time it was carried into effect; and it is even stated that it is at the present time inoperative, and that there have been considerable dissensions between the companies in the competition for business. It is further stated that the two companies will either have to come closer together or further apart, which practically means either consolidation or the abrogation of the present agreement. The present policy, it is stated, is working to the detriment of both companies, while outside interests are making great headway in securing large contracts, which the parties to the compact feel that they should themselves have received.

On the contrary, it is officially stated that this statement is unfounded, and that the patent agreement between the two companies has worked very satisfactorily, and the relations under it are and have been harmonious.

More Cable Lines to Be Refitted Electrically in Washington.

The Capital Traction Company, of Washington, D. C., has decided to discard the cable traction system on the Seventh Street line and put in the under-running trolley system. This is the same company whose cable power house for the Fourteenth Street line was recently burned, in consequence of which the company decided to replace the cable lines affected with an underground conduit electric system. The work is now so far advanced on the Fourteenth Street line that it will probably be in operation by the first of the year. As soon as the electric cars are running, the horse cars now doing temporary duty on Fourteenth Street will be transferred to the Seventh Street line, and the cable now in use there shut down to allow the placing of the conducting rails in the existing cable conduit.

English Fire Departments.

One of our English contemporaries comments approvingly on the advance made in an English city in connecting the houses of the firemen by wire with the fire engine houses. It seems that it is customary in most places to summon the firemen by ringing the fire bell, a fact which may recall to Americans of the last generation the volunteer fire brigades of the olden times. Since the recent severe fire in London that city is contemplating the establishment of a fire-alarm system.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Force Exerted on the Iron of Armatures. DESOMBRE. *L'Eclairage Elec.*, Nov. 28.—A communication discussing the question recently referred to by Mordey and others, concerning the application of the force in the case of a wire in a toothed armature; he states that the result is evident *a priori*. This is followed by another brief communication showing analytically the difference in the magnitudes of the forces on the iron and the windings.

Armatures with Holes and Teeth. FLEISCHMANN. *L'Eclairage Elec.*, Nov. 20.—A translation, in abstract, of the article noticed in the *Digest*, Oct. 2.

Driving Exciters.—Lond. *Elec. Eng.*, Nov. 26.—Answers to a question as to the relative advantages of driving exciters from the alternator shaft, direct or by belt, or by an independent engine.

Simple Method of Starting Alternating Current Motors. ARNO. Lond. *Elec. Rev.*, Nov. 26, and *L'Ind. Elec.*, Nov. 25.—Translations from the Italian of the two papers which were abstracted in THE ELECTRICAL WORLD last week.

Commutator Segments. CORSON. *Amer. Elec.*, Dec.—It is recommended that the conical bearing of commutator segments be placed below the centre of the bar, in order that when the bar is worn, the line of thrust shall not be above the worn surface. With such bars it is desirable to put a bearing in the centre if they are apt to be worn very thin, which bearing may be in the form of a ring slipped on the shaft and covered with the necessary insulation to prevent short circuiting; a portion of the inner edge of each bar could be milled off to receive the insulation bearing ring, which in turn could be slipped, with its insulation on, into the commutator when it is built up; the ring would bake to the segments, as the shellac is evaporated, and a very solid form of commutator would be the result, and one free of vibration when worn considerably.

LIGHTS AND LIGHTING.

Photometric Measurements of the Alternating Current Arc. WEDDING. *Elek. Zeit.*, Nov. 25.—A long article, accompanied by a large number of curves giving the results of some extended researches; at present data concerning the light from alternating arcs are very conflicting, making a comparison with continuous current arcs almost impossible; the present experiments were made to supply this information. He endeavored to find the effect of reflectors, the effect of the diameter of the carbons, the dependence of the amount of light on the current and power, and make a comparison between alternating and direct current lamps. The lamp used is well illustrated; it is a focusing lamp and depends for its regulation on the so-called Thomson effect; the current used followed the sine law almost exactly. The results are mostly the curves of illumination in a vertical plane below the horizontal, and of these thirty-three sets of curves are given; these and the tabular data constitute the chief material of value in the article, as there are but few general conclusions drawn. Among the latter he mentions the following; by means of a reflector the amount of light below the horizon is increased almost one-half; he appears to find no appreciable effect of the form of the current curve on the amount of light; one of the curves gives the specific power as a function of the total energy in the lamp and this shows that at a consumption of 75 to 250 watts for a current of 4 to 9.3 amperes the consumption per candle diminishes very rapidly; from 250 watts the curve falls slowly and nearly in a straight line, the specific consumption, that is, the watts per candle, diminishing regularly with an increase of the current; the sharp bend at 9.3 amperes shows that it is not economical to run alternating arc lamps with less current than 9 amperes. Another curve shows the relation between the current strength and the mean spherical intensity; he shows that up to 25 amperes the relation is a simple proportion, but with stronger currents the amount of light developed increases more rapidly; for the straight portion of the curve the mean spherical intensity is equal to 43 times the current minus 160, which equation applies to anything less than 25 amperes, or it is equal to 1.4 times the watts minus 102, this applying up to 700 watts. A curve is given showing the relation between the maximum and the mean spherical intensity; the first part of a curve up to 800 candles is practically a straight line beginning at the origin from which it follows that the maximum is equal to 1.46 times the mean spherical. In conclusion he compares alternating and continuous current lamps, using previous determinations of others and giving both curves together; the great difference is quite striking; while an alternating lamp begins at 200 watts to be tolerably economical, the direct current one at 60 watts has the same watts per candle; the alternating lamp at 1100 watts runs at 0.68 watts per candle, while the continuous current lamp has the same efficiency at 150 watts; at greater consumptions the specific consumption for continuous current is much less than for the alternating current, being approximately about one-half and for greater currents two-thirds; on the other hand three alternating lamps may be run at 110 volts, as compared with two continuous current lamps, and the distribution of light will therefore be better.

Alternating Current Arc Lamp. *L'Ind. Elec.*, Nov. 25.—A brief illustrated description of the new Henrion lamp, which is operated by means of a small reversible non-synchronous motor.

Low Frequency and Incandescent Lamps. *L'Ind. Elec.*, Nov. 25.—It has been stated that owing to the low frequency of the current at the Niagara Falls plant, flickering is produced in the low candle power lamps, such as the 8 and 10, while the use of 5-cp lamps is impossible. The present note suggests as a simple remedy reducing the voltage directly to 50 instead of 110, as the filaments of the 50-volt lamps are so much larger that the fluctuations in the light will not be noticed.

POWER.

Cranes and Elevators. RAVENSHAW. Lond. *Elec.*, Nov. 26.—A continuation of the reprint of his paper (see *Digest*, last week). He discusses the use of separate motors for each motion, and a single motor with clutches, seeming to favor the latter, but adding that there is little to choose between the two systems, both of which are largely used with good results. He then describes, with the aid of illustrations, the 20-ton electric crane at the Woolwich Arsenal, with special reference to the details of the electrical gear; the results of a series of tests are also given.

Crane.—Elek. Anz., Nov. 14.—An illustrated description of the combined installation for operating cranes and lights on a large dock in Hamburg. The continuous current is used in connection with a battery of accumulators; some experimental data for a crane are given.

Electric Power in Ship Yards.—Lond. *Elec.*, Nov. 26.—Abstracts of papers by Westgarth and Bigge, noticed in the *Digest*, last week.

Refuse Destructors at Shoreditch.—Lond. *Elec. Rev.*—Recent numbers of this journal contain communications regarding this plant; it appears that coal is used on Sundays because on those days no refuse is brought to the works; the discussion refers chiefly to the coal consumed.

Electric Light from City Refuse. PERRY. *Cassier's Mag.*, Dec.—A long, illustrated article describing the plant at Shoreditch, England, to which a number of references have already been given in the *Digest*. In his conclusions he states that the saving in the expenses of the disposal of the refuse amounts to about $11,000 per year, and the plant is said to be an entire success. In New York City the cost of the disposal of garbage is 94 cents per load; in Hamburg, where it is also cremated, the cost is 35 cents per ton, and in Shoreditch about 29 cents; if in New York City the price could be reduced in this way to 50 cents per ton there would be an aggregate saving of over $700,000 per year, which if capitalized amounts to enough, when duly invested, to light the whole of the island with electric lights.

Rating Power Plants. ALDRICH. *Elec. Rev.*, Dec. 8.—The beginning of a reprint in full of the American Society of Mechanical Engineers paper on the rating of electric-power plants upon the heat-unit standard, which was abstracted in THE ELECTRICAL WORLD last week.

TRACTION.

Heilmann Locomotive.—L'Eclairage Elec., Nov. 13, *L'Energie Elec.*, Nov. 16, and *L'Ind. Elec.*, Nov. 25.—The two former journals contain long illustrated descriptions of the new locomotive, including a plan, elevation and the details; a full-page portrait of the inventor is included in the second; the latter journal contains a shorter article by Hospitalier, including an illustration of the complete locomotive with dimensions and data,

accompanied by a brief description; the maximum power of the engines is 1350 indicated horse-power, and the power at the periphery of the wheels is 1000 horse-power; the coefficients of traction for various grades and speeds are given; it appears that a speed of 72 miles per hour was obtained. The probable success of this form of locomotive is discussed, and it is claimed that it will draw only with difficulty 100 tons at a mean velocity of about 60 miles per hour; present locomotives of 50 tons weight or 80 with a tender, as compared with 170 tons, will easily draw a train of 100 tons at that velocity (presumably 60 miles an hour) with much less power, at much less weight and for a less first cost; the amortization alone represents 1.5 times the total consumption of coal, which alone overbalances the economical advantages claimed; the results, it is claimed, simply corroborate the opinion that the system is not a success.

Electric Railways in Europe.—Elek. Anz., Nov. 4.—Two large tables containing columns of statistical date for twenty-eight lines which have been constructed and twenty-one others under construction by the General Electric Company of Germany; the lines are mostly in Germany.

Accumulators in Power Houses. Schroeder. Lond. *Elec. Rev.*, Nov. 26.—A translation in abstract of the French abstract noticed in the *Digest*, Oct. 30; a number of the curves and diagrams are reproduced.

Railways. Pellissier. *L'Eclairage Elec.*, Nov. 13 and 20.—Brief illustrated descriptions of recent improvements, taken apparently from patent specifications.

Radius of Action of Electric Motor Carriages. H. P. Maxim. *Sc. Amer. Sup.*, Dec. 11.—A reprint of a paper, in which he gives his experience with a trip made in New England with an electric carriage, for the purpose of finding whether there was any great difficulty in having the batteries recharged on the route; he experienced no difficulties on the trip. He found that the cost of the current at the different stations at which he stopped was such as to make the cost of running between 1.5 and 2 cents per mile; in a number of instances he found that the current consumed in a run of 20 miles was returned to the batteries in 1.5 hours; he concludes with a table showing the number of electric light stations in a large number of States.

The Future of Self-Propelled Vehicles. Woods. *West. Elec.*, Dec. 4.—A long article of a general character, outlining the possible future application and giving some tabular data for several forms of vehicles with two motors.

Electric Elevators. Moses. *Eng. Mag.*, Dec.—An article on the standards of practice in electric elevator installation, giving general hints and data, together with illustrations of some of the details in different systems. In the concluding paragraphs he states that the cost of operating electric elevators is lower than for any other practical method; the power per car mile in office buildings varies from 2 kilowatt hours with an over-balanced worm, to 4 kilowatt hours with an underbalanced screw; at 10 cents per hp-hour for small, and 10 cents per kw-hour for large consumers of energy from a central service, the cost per month will be from $3 to $10 for residences, $10 to $20 for apartment houses, $15 to $40 for small office buildings, and $40 to $90 for tall office buildings; he considers electric elevators to be the safest means of travel known.

Railway and Power Generators.—Eng. News, Nov. 25.—A long article, accompanied by a large insert, illustrating some slow speed direct connected generators built by the General Electric Company, and which, it is claimed, may be taken as fairly representing the best American practice of to-day; curves are also given showing the comparative dimensions of the parts of multipolar direct connected generators for power purposes; also curves showing the efficiency of a generator at different rates of speed.

Towage on Canals.—Sc. Amer. Sup., Dec. 4.—An abstract, with a large number of illustrations, of the recent paper by Robinson, read in England some time ago and duly noticed in the *Digest*. The issue of Dec. 11 contains a further illustrated description of the system used.

Electric Railway Practice. Parham. *Amer. Elec.*, Dec.—The first portion of an article giving instructions for installing a trial equipment, and dealing with the setting up of the motor, gears, insulation, testing and the trial of the motors and gears.

West End Railway.—West. Elec., Dec. 4.—Extracts from the recent directors' report, including data concerning this system of lines in Boston.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Depreciation of a Plant.—Lond. *Elec. Eng.*—A few answers to a question asking whether it is necessary or desirable to depreciate the value of a municipal plant as the capital is repaid by periodic installments.

Bradford.—Lond. *Elec. Rev.*, Nov. 26.—A brief illustrated description of the recent extensions to this plant.

Vienna.—L'Ind. Elec., Nov. 25.—Some extracts from a recent official report concerning the distribution of electrical energy in that city.

Transformer Sub-station.—Zeit. fuer Elek., Nov. 15.—An illustrated description of the Probst system of enclosing and protecting transformers in sub-stations.

Flushing.—West. Elec., Dec. 4.—An illustrated description of this central station, which is claimed to be an unusually compact one; particula attention was given to details to insure economical operation.

Handy Tools in a Generating Station.—Amer. Elec., Dec.—Descriptions are given of a support for a tool-rest for use in turning down commutators; an end play device for an armature shaft and a device for application in sand-papering commutators are also described.

WIRES, WIRING AND CONDUITS.

Insulators for Line Work.—L'Energie Elec., Oct. 1.—Illustrated descriptions of a number of forms of porcelain insulators as made in France, chiefly of the multiple petticoat type.

Fuses versus Circuit Breakers. Cutler. Sachs. *Amer. Elec.*, Dec.—Further articles in a lengthy discussion of the relative values of fuses and circuit breakers. Cutler asserts that the best use for circuit breakers seems to have narrowed down to where the load is extremely variable and excessively abnormal currents are of very frequent occurrence, but even in these cases the circuit breaker is a nuisance through continually operating at very little abnormal and merely temporary fluctuations; he describes a new type of a circuit breaker depending for its action upon the combined magnetic and heating effect of the current, a part of which apparatus is illustrated, but no account is given of its principles beyond the statement that the operation of a small magnet shown in the illustration is controlled by the heating effect of the current. He states that if this type of circuit breaker is set for 100 amperes 150 amperes will flow for nearly a second, 140 amperes for about two seconds, 130 amperes much longer, and so on. Sachs claims as one of the advantages of the fuse over circuit breakers that the action of the former depends upon the square of the current, and the latter only directly upon the value of the current. He considers that a fuse worked at a maximum running point which comes close to the blowing point, and has, in addition, the property of involving time and a gradual breaking off of the current, is superior to circuit breakers which act instantaneously. He believes that enclosed fuses can be utilized and renewed with almost the same facility as any circuit breaker of the same capacity, except when the renewal of the circuit becomes a matter of the utmost purpose and the operation of the protective device is so frequent as to prohibit, for commercial reasons, the use of a destructible cut-off.

ELECTRO-PHYSICS AND MAGNETISM.

Carbon Coherers. Brown. Lond. *Elec.*, Nov. 26.—He found that it was of service only when used as a receiving instrument in conjunction with a telephone, but when a relay is used, metallic granules are more sensitive and better, because they cohere more completely; metals break down their contact resistance suddenly and completely, while the variation in carbon is much smaller; this property of carbon is useful where very rapid impulses are to be received. Where sharp de-cohering is not required, but only single responses to minute radiation, an extremely sensitive coherer may be made by lightly balancing a very small platinum point on the surface of a piece of blued steel. For continuous Morse signalling he finds the Branley tube of filings, with certain modifications, to be the most effective form.

Effect of Lightning on a Coherer. Englisch. *Elek. Zeit.*, Nov. 25.—A short communication describing experiments. Simultaneous measurements were also made with the electroscope, showing that there was no inductive action; he shows that all kinds of lightning do not affect the coherer; the so-called sheet lightning never had any effect; silent discharges between clouds, as also between clouds and the earth, produced effects.

Minute Spark Gaps. Salvioni. *Nuovo Cimento*, Oct.; abstracted briefly in the Lond. *Elec.*, Nov. 26.—He describes a plan for producing extremely small spark gaps; the knobs consist of amalgamated platinum, made by letting an arc play between a platinum wire and a mercury surface; these are of great durability; the apparatus acts very much like an elementary coherer; when the critical distance for a given voltage is nearly reached, a slight shock will start the discharge.

Electric Waves. Campbell. Lond. *Elec. Eng.*, Nov. 26.—A brief summary of a recent lecture; the abstract contains but little information.

Deformation of Currents by Self-Induction. Eisler and Reithoffer. *L'Eclairage Elec.*, Nov. 13.—A long translation in abstract of the article noticed in the *Digest*, Jan. 2.

Theory of Action at a Distance. Vaschy. *L'Eclairage Elec.*, Nov. 13. A short theoretical article on the question of masses.

Longitudinal Light. Jaumann. Lond. *Elec.*, Nov. 26; abstracted from the *Wien. Ber.*, July.—He defends his theories and conclusions against the doubts expressed by others on the genuine character of his alleged interference surfaces produced in cathode rays; he repeated the experiments and obtained these surfaces in a more pronounced form.

Velocity of Cathode Rays. Majorana. *L'Eclairage Elec.*, Nov. 13.—A translation in abstract from the Italian. Descriptions of some researches from which he calculates a velocity of 600 kilometers per second, which is much more than the figure 190 obtained by J. J. Thomson; he concludes that the cathode rays are a mixture of rays of different velocities, varying from 100 to 600 kilometers per second; when deflected by a magnet those rays which are more easily deflected are those which are propagated at the least velocity.

Electric Discharges in Rarefied Gases. LAMOTTE. *L'Eclairage Elec.*, Nov. 20.—The beginning of a long article which appears to be a review of recent researches, especially those by Wiedemann.

Electric Earth Currents Viewed Astronomically. COTTERELL. Lond. *Elec. Rev.*, Nov. 5 and 26.—The conclusion of his long serial (see *Digest*, Nov. 13). He discusses the effect of the earth's rotating in another magnetic field, such as that of the sun or other bodies in the universe; the effects of the periodicities of the astronomical movements are also considered. He suggests a theory and makes deductions from it, both of which he thinks are warranted.

Modifications Produced by Magnetization. HURMUZESCU. *L'Eclairage Elec.*, Nov. 20.—A short article in which he discusses the mechanical deformations and variations in resistivity, which are brought about by magnetization.

X-Rays and the Tubercle Bacillus. POTT. *Elec. Rev.*, Dec. 8; reprinted from the London *Lancet*.—He gives the results of experiments which were undertaken to ascertain the effect of X-rays on cultivations of the tubercle bacillus, and the conclusions were that they had no effect; he believes that the improved condition of patients who have been submitted to these rays was due to other causes.

Carbon Detector for Hertz Waves. JARVIS-SMITH. *Elec. Rev.*, Dec. 8.—A reprint of the article noticed in the Digest, Dec. 4.

Magnetarium.—Sc. Am. Sup., Dec. 4.—A brief illustrated description of the apparatus suggested by Wilde at the French Academy, with which he reproduced the phenomena of terrestrial magnetism by means of electric currents and a globe.

Inductance —Amer. Elec., Dec.—The current installment of "Lessons in Practical Electricity" is on the application of the clock diagram to the solution of practical problems in inductance.

Electrical Catechism.—Amer. Elec., Dec.—The current installment treats of alternating current lag and the application of Ohm's law to alternating currents.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Zincing. COWPER-COLES. Lond. *Elec. Eng.*, Nov. 26.—A long illustrated abstract of a recent paper. While steel has many advantages over iron for constructing purposes, it possesses the serious drawback that it corrodes more rapidly; the best way of preventing this is by covering it with zinc; he reviews the development of the hot galvanizing process and then gives some information concerning the electric process; in the hot process the zinc usually contains lead, tin and iron, and the zinc is therefore likely to be brittle; the zinc applied electrically is very pure and stands the British post office test for galvanized wire very much better; articles so coated will stand the ordinary corrosion due to atmospheric influences much better than when covered by means of the hot process. He describes briefly some of the difficulties encountered in the electrical method, and then gives a description of a plant for this purpose.

Decomposition of Sodium Chloride. LORENZ. *Zeit. f. Elektrochemie*, Nov. 20.—He endeavors to show how the difference between the voltage of decomposition and that actually observed can be explained; he made very careful determinations between platinum terminals and obtained 1.95 volts as the least necessary for starting the decomposition of salt; in practice the figures are about 2.3 to 2.1. His explanation is not very clear.

Separating Metals. WALLER. *Zeit. f. Elektrochemie*, Nov. 20.—Descriptions of methods for electrolytically separating cadmium and zinc, zinc and cobalt, antimony and tin.

Jacques Cell Discussion. THOMSON. ANTHONY. *Amer. Elec.*, Dec — Thomson gives a brief statement of some facts concerning the action of the Jacques cell; he finds that carbonic acid does not escape from the cell in action, and that there is a formation of a carbonate whether electricity be taken from the cell or not, and at nearly the same rate, so long as air is passed into the electrolyte; a comparison is made between a voltaic couple formed by dissolving some copper in sulphuric acid, to which is regularly added an oxidizing agent; if the oxidizing agent be supplied continually, sulphate forms continuously; and if while the copper is dissolving, a carbon plate is immersed in the liquid and the circuit completed from the carbon to the copper, electrical energy may be obtained while the reaction goes on. The energy given out both in this case and the case of the Jacques cell may be all heat within the cell or partly electrical energy in an outside circuit; and the source of the heat or electrical energy is evidently the combination to form a stable chemical compound, which in one case is copper sulphate and in the other sodium carbonate. Anthony restates his position in the discussion, which is that the oxygen in the Jacques system acts as a depolarizer and that the energy of its combination with a positive ion at the iron electrode and not around the bubbles straying through the cell furnishes electrical energy and not heat; he considers that if the oxygen were carefully kept from the carbon in the Jacques cell, and brought into the top of the cell, the carbonate formed would be found to be very nearly the equivalent of a current, and that its formation would practically cease when the circuit was opened.

Twenty-five Years' Progress in Secondary Batteries. HEPSTEIN. *Elec. Rev.*, Dec. 8.—A reprint of the article noticed in the *Digest* last week.

Obtaining Metals from Ores. TELFAIR process. *Eng. and Min. Jour.*, Dec. 4.—A brief reference to this process, which is editorially claimed to be an absurd one; it was claimed that gold, silver and copper may thereby be removed from the earth without mining, crushing or smelting the ore; a "powerful alternating current" (*sic*) is passed through the earth containing the metal, and it is claimed that thereby the atoms are caused to travel to the "negative" pole of the circuit, at which place they are received in a huge tank on a plate in an alkaline solution; these statements are said to be nonsense and are given as a warning to prospective investors.

Rhodin Apparatus.— Eng. and Min. Jour., Nov. 27.—An illustrated description of this apparatus, which was recently described in the foreign journals.

Absorption of Nitrogen by Carbon Due to the Silent Discharge. BERTHELOT. *Am. Jour. Sc.*, Dec.—An abstract of this article from the *Comptes Rendus*, 124, p. 528.

Chemical Action of Electrical Oscillations. HEMPTINNE. *Am. Jour. Sc.*, Dec.—A longer abstract of the original article, a notice of which was referred to in the *Digest*, last week.

Behavior of Argon in X-Ray Tubes. CALENDAR and EVANS. *Sc. Am. Sup.*, Nov. 27.—A reprint of their recent British Association paper.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Our Knowledge of the Value of a Resistance. AYRTON. Lond. *Elec.*, Nov. 26.—An interesting article on the general subject of the accurate measurement of large and small resistances, with special reference to the use of the Lorenz apparatus to replace the standard coil resistances, which apparatus he recommends very highly. He calls attention to the necessity of being able to measure very low resistances very accurately; a ten-thousandth of an ohm, for instance, is quite an appreciable resistance when currents of 5000 amperes pass through it and the measurement of such a resistance to 1 per cent., that is, to one microhm, will soon be regarded as merely a piece of rough workshop measurement; he suggests measuring such resistances by means of the current and the voltage, and states that we can ascertain the value of such a resistance by means of electrolysis and a Clark cell, to a greater accuracy than we know the electro-chemical equivalent of silver or the E. M. F. of the Clark cell; to measure currents of about 1000 amperes electrolytically correct to one ampere would be attended with many practical difficulties, however, and it would, therefore, be better to measure the value of some smaller current electrolytically, and then determine the value of the larger current by some method giving their relative values. With a properly constructed Lorenz apparatus, the value of a 100-microhm strip could easily be ascertained in absolute measure to within 0.1 per cent., and with sufficient care to probably two or three parts in 10,000; in other words, not only can a very small resistance be measured far more easily with the Lorenz apparatus than by direct comparison with the standard ohm, but the result can be obtained in absolute measure to a greater degree of accuracy than that with which the value of the standard ohm will probably be known. It may be urged against this apparatus that only a small resistance can be measured by it, which, on the face, is true, but there is a way of getting over this difficulty. He endorses the recommendation of Jones, that the standard ohm should be defined by means of the Lorenz apparatus, and the government standards should be in the form of such an apparatus. In conclusion he discusses the question of what degree of accuracy can be obtained in the measurement of a resistance in absolute measure to-day; he gives the results of the last three absolute determinations. This is followed by a reprint of the article, by Ayrton and Jones, on the determination of the ohm, which was noticed in the *Digest* last week.

Inverted Form of Board of Trade Standard Cell. CALLENDAR. Lond. *Elec.*, Nov. 26.—A long communication, in reply to the one by Kahl (see *Digest*, Nov. 6); the cell which the latter refers to differs so completely in all essential details from those described by the present author and Barus that he now gives a comparison between the two forms; an illustrated description of one of his laboratory cells is included.

Temperature Variations in Clark Cells. COOPER. Lond. *Elec.*, *Elec. Eng.* and *Elec. Rev.*, Nov. 26.—A note correcting a mistake in the report of a Physical Society paper. When using a Board of Trade form of this cell under ordinary conditions in which rapid changes of temperature are avoided, it is unnecessary to consider the lag because the absolute value of the E. M. F. is not known to a greater accuracy than one-tenth of 1 per cent.; when, however, it is not the actual value but the constancy of the cell which is concerned, the lag may be a serious question.

Measuring Dielectric Constants. DRUDE. *Zeit. Phys. Chem.*, 33, p. 265; abstracted at considerable length, including large tables and illustrations, in the *Zeit. f. Elektrochemie*, Nov. 20.—He describes the two methods for measuring dielectric constants and electric absorption by means of rapid oscillations; the tables give the results for a large number of compounds.

Induction Coil. WYDTS and ROCHEFORT. *L'Eclairage Elec.*, Nov. 20.—A brief description of the modified induction coil, chiefly for X-ray work. A single secondary coil is placed around the middle of a primary, and the whole apparatus is placed in a jar filled with an insulator in the form of a paste; sparks averaging 25 cm were obtained with five volts and four amperes; the internal resistance being small the secondary current is greater, which is an important element in X-ray work.

Mercury Interrupter for Induction Coils. Hofmeister. *Elek. Zeit.*, Nov. 25; an abstract, with the illustration, of an article from the *Wied. Ann.*, 62, p. 379.—It consists essentially of a small motor driving a disc and a shaft with three radial wires; the disc runs in mercury continually, while the three wires dip into the mercury in succession, the two mercury cups being insulated from each other; the mercury is covered with water.

Scales. Martens. *Zeit. f. Elektrochemie*, Nov. 20; noticed briefly from the *Wied. Ann.*, 62, p. 206.—He describes a method of illuminating a glass scale so that the marks are light, on a dark background. The lines are scratched as usual and a beam of light is directed into the glass through the ends of the plate of glass; they will then make the scratches appear light, while the background itself will be dark.

Measurement of Alternating Currents. Rowland. *Am. Jour. of Sc.*, Dec.—A long article treating of the measurement of inductances, self and mutual, and of capacities, together with other ratios and values in absolute measure; he also describes a few methods of resistance measurements which are more accurate than those usually given by means of telephones or electro-dynamometers; besides some of the old methods he includes many that are claimed to be new and which depend upon making the whole current through a given branch circuit equal to zero; some of his new methods depend on adjusting two currents to a phase difference of 90°, which principle he believes to be new; this is done by passing one current through the fixed and the other through the suspended coil of an electro-dynamometer, whereby the sensitiveness is multiplied possibly 1000 times over the zero method; many of the methods also become very simple if mutual inductances are used, made of twisted wires wound into a coil. By these various methods he believes the measurement of capacities and inductances is as easy as those of resistance, while the accuracy is vastly improved. Twenty-six methods are described by means of diagrams accompanied by an analytical discussion. The results of his experiments seem to settle the question as to standard inductances or capacities which have a real constant, which can now be compared to at least one part in 10,000.

Water Rheostats. Willis. Merrill. *Amer. Elec.*, Dec.—Willis gives practical information for the use of water rheostats in the absorption of large quantities of electrical energy. In one test a plate 1 foot by 5 feet by 1 1-4 inches thick submerged 2 feet over a dock, absorbed the energy of 800 amperes at 625 volts, the maximum immersed surface being 2 square feet. In another test with the same plates, the energy of 1450 amperes at 550 volts was absorbed, the maximum immersed surface being 4 1-2 square feet. In another test a tank 4 feet by 4 feet by 5 feet was used, which, it is claimed, could easily handle 1000 amperes at 550 volts. In this case the maximum current density per square foot used was 280 amperes. For the usual run of work in testing, etc., a barrel water rheostat is described, consisting of two concentric cylinders of galvanized sheet iron separated 3 inches and immersed in a barrel of water containing about a tablespoonful of salt. He states that for currents under 50 amperes it will probably be better to use no salt at all, simply starting the rheostat and letting it run a while until the electrolytic action had produced sufficient conductivity. Merrill gives the results of tests on different kinds of plates and solutions for water rheostats; salt was found very untrustworthy for accurate work, the chlorine gas set free eating away the electrodes and forming a scum of comparatively low specific resistance, which scum, moreover, served to imprison bubbles of hydrogen, resulting in explosions in some cases through ignition from sparks when contact was broken. He found that a sulphuric acid solution gave fairly uniform results; the gas escaped freely over the surface of the electrodes, and the corrosion was slight.

Primary of Induction Coils.—Amer. Elec., Dec.—The effect on the time constant of the reduction of the resistance of a primary coil is considered; at the break this reduction of resistance can be neglected, for the reason that the resistance of the arc is so great in comparison that the former does not enter to any appreciable extent; consequently since the length of the spark will depend entirely upon the self-inductance of the primary, this should have the fewest possible number of turns. At the make, when there is no external resistance, the rapidity with which the magnetism is built up is neither increased nor decreased by reducing the number of turns. The conclusion is that a great advantage is obtainable at the break by reducing the primary turns to a minimum, and at the make no disadvantage arises from so doing.

Photometer for Measuring Illumination.—Prog. Age, Dec. 1.—A translation from a French gas journal of a short article describing the Weber photometer and its application for measuring daylight; a diagrammatical illustration is included. A tube has a benzine lamp at one end, a movable screen in the middle, and another tube at the other end, at right angles to it, capable of turning around the axis of the first tube; this second tube has an eye piece on one end and a screen on the other; a reflecting prism enables the first-mentioned screen illuminated by the lamp to be seen together with the second screen, the former being moved nearer to or farther from the lamp until both appear to be illuminated equally. The illumination of a surface is then calculated from the distance of the first screen from the lamp, and from the height of the flame, the formula for this being given. The translation is not so clear as might be desired.

Construction of a Wheatstone Bridge. Hobart. *Amer. Elec.*, Dec.—Instructions are given for the winding and calibration of a home-made Wheatstone bridge.

Magnetic Method of Detecting Metallic Iron. Duane. *Am. Jour. Sc.*, Dec.; noticed very briefly from the *Wied. Ann.*, No. 11, p. 543.—He shows that the damping effect of a steady field on oscillating bodies is a more delicate method than chemical investigations, for the detection of traces of iron; the method is even more sensitive when a rotating magnetic field is used.

Taking the Speed of Motors. Eastlake. *Amer. Elec.*, Dec.—The construction of an acoustic speed indicator is described, and instructions given for its use.

Dynamo Testing.—Amer. Elec., Dec.—The Hopkinson method of dynamo testing and some of its modifications are described.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphy Without Wires. Slaby. *Zeit. fuer Elek.*, Nov. 15.—A description of his recent researches, including some of the diagrams (see *Digest*, last week).

Capacity of Submarine Cables.—Lond. *Elec. Rev.*, Nov. 26.—A short discussion of the points at issue in the recent discussion of Murphy and Young in the Lond. *Elec.*

Domestic Telephone System.—Zeit. fuer Elek., Nov. 15.—A brief illustrated description of a simple system for short distances in which there is a microphone, but no separate batteries or induction coil.

Telephone Stations.—Elek. Zeit., Nov. 25.—An editorial calling attention to the great importance, in the construction of telephone stations, of considering and providing for interurban service.

Telephone Club Lines. Fitch. *Amer. Elec.*, Dec.—A form of magneto bell used on a club circuit system is described. It was found that with bells made upon the Watson plan the impedance of the ringer magnets was so great that magnetic transmitters were impracticable for "club" line circuits; a ringer magneto was therefore constructed which is claimed to have practically no magnetic impedance to speech currents. The boxes are wired with a ringer, generator and receiver in series, the ringer being permanently in the main line, the generator normally shunted in one of the common ways and the receiver circuit short-circuited when not in use; the upward movement of the lever closes the transmitter battery circuit and the downward movement connects together the two usual cord binding posts, thus short-circuiting the receiver and transmitter circuits.

Automatic Signals. Spicer. *Eng. News*, Dec. 2.—A long abstract of a recent paper read before the Railway Signal Club of Chicago, discussing the systems of automatic signals on railways.

MISCELLANEOUS.

Welding and Brazing. Voltex process. Lond. *Elec. Eng.*, *Elec.* and *Elec. Rev.*, Nov. 26.—A brief illustrated description of this process, which consists in the use of an electric arc formed between two special carbon rods inclined to each other at an angle of about 90°, the apparatus being held in a holder which can generally be held in one hand, and which contains a nob and a small nut by means of which the arc is struck and the carbons fed together; the arrangement of inclined carbons has the advantage that the arc is deflected in a sort of jet without the use of a magnet. The first journal also gives comparative figures of the cost of brazing and filling up a bicycle frame as given by the makers of this apparatus; with gas and coke, gas costing 70 cents per 1000 feet, the complete cost, including finishing, is $1.43, while with the electric process, at 6 cents per kw-hour, it is only 46 cents.

Reproduction of the Diamond. Majorana. *L'Eclairage Elec.*, Nov. 20; abstracted from the Italian.—A description of some experiments made to show that pressure and heat are the only things required for making diamonds from carbon, or in other words, that the solution of the carbon in the metal which surrounds it is not a necessary part of the operation. The apparatus is described and illustrated; the carbon is heated in the arc and when very hot it is suddenly compressed in a small cylinder directly beneath it, the compression being produced by exploding some gunpowder in a cylinder directly above it, in which moves the piston which compresses the carbon.

Muscular Electricity. Wright. Lond. *Elec. Rev.*, October 22, Nov. 5 and 26.—The conclusion of his long serial. There are no general conclusions drawn, except that he believes the study of the electrical conditions of muscular fibre is an extremely interesting subject, and one which is likely to develop considerably.

Electric Heating.—Amer. Elec., Dec.—Description of a practical application of electric heating in a straw hat factory. The electrically heated appliances consist of special hatters' flats, large and small flat irons, circular flat stoves, glue pots and a number of special press heads; the total capacity of these is about 20 kilowatts, but, as ordinarily used, the average consumption of current corresponds to only about one-half of this. Bare Krupp resistance wire is used, enclosed in the interior of the casings. The hatters' flats take five amperes each, at 105 volts; a submerged resistance coil is used to heat the glue pot at the beginning, after which the glue is kept at the desired temperature on small electric stoves. A very large economy is claimed for the electric over the gas heating, which it displaced.

Blasting Fuses. VAN DETH. *Amer. Elec.*, Dec.—A blasting fuse is described, designed for a spark jumping across a small gap, which gap is filled with a mixture of antimony, sulphite and potassium chloride; the fuse is fired by an induction coil or by a magneto, the former being used if there are a number of mines with fuses all connected in series.

Mercury Pumps.—Sc. Am. Sup., Nov. 27.—Illustrated descriptions of two improved forms of mercury pumps, one by Henriet and another by Alban.

Mathematics for Engineers. WOLCOTT. *Amer. Elec.*, Dec.—To the question, How much mathematics must an engineer know? the answer is given, very little beyond arithmetic; the too frequent use of graphic methods is condemned; the habit of leaning on graphic constructions always and never able to stand alone is pronounced a great hindrance to the acquisition of a sound knowledge of mathematics; vector analysis is not viewed with favor.

How to Become an Electrical Engineer. LAUDER. *Elec. Rev.*, Dec. 8.—A short article which received the first prize awarded by that journal for articles on this subject.

Logarithmic Cross-Section Paper. DURAND. *Amer. Elec.*, Dec.—The construction and uses of logarithmic cross-section paper are described, and its value pointed out for use in plotting some electrical curves, such as those representing hysteresis values.

A New Battery Motor.

The Kent Electric Manufacturing Company, Worcester, Mass., is bringing out a battery motor which, it is said, differs radically from other motors now on the market. It has one bearing, 3 inches long, extending nearly through the armature, thus preserving the alignment of the shaft. There is no bearing on

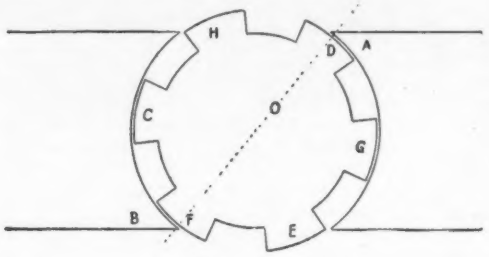


FIG. 1.

the commutator end. This avoids the danger of covering the commutator with oil, and insulating it from the brushes.

The armature is of the company's drum type, 2½ inches in diameter by 1¼ inches long. The binding posts are placed on each side of the field coil, and are entirely out of the way. The pulley is made of cast iron, and fastened to the shaft by means of a set screw.

This motor is wound for a normal current of six volts, but can be run on from one to twelve volts, the power varying with the voltage. It may be used for any light work requiring less power than a sewing machine. The accompanying illustration (Fig. 2) shows its construction and the position of the bearing. The armature in this machine, as in the other machines of this company's make, is an improvement over three-pole armatures. With the ordinary three-pole armature the magnetic torque is unevenly distributed at the different positions in a revolution. This gives it a rattling motion, especially with a load, and consequently a great wear on the bearings.

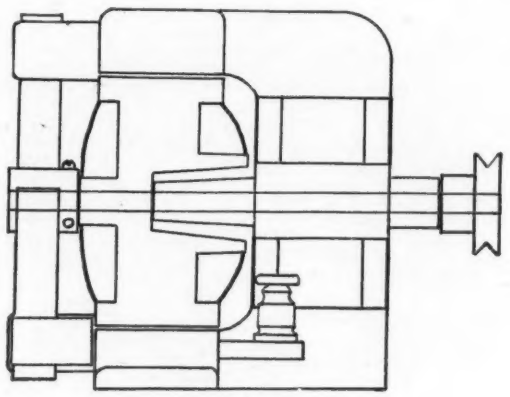
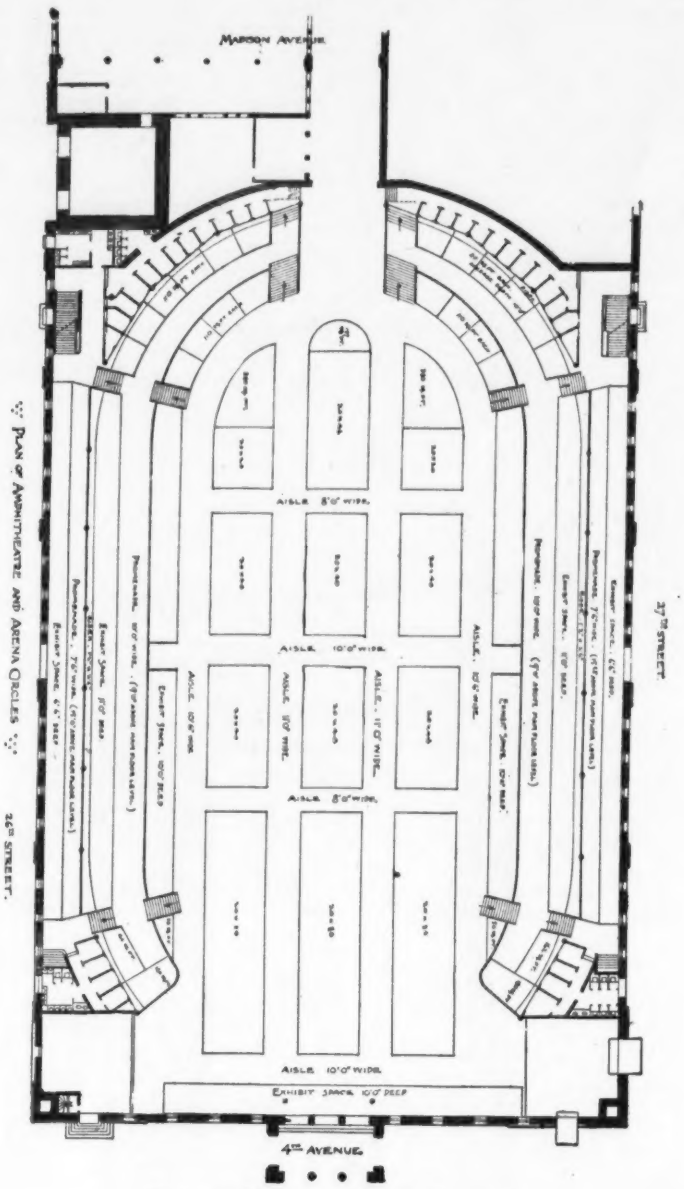


FIG. 2.

Fig. 1 represents the new Kent armature, which has six poles. As pole *D* approaches pole *A*, and the radial pull, *O D*, is exerted, there will be a corresponding radial pull diametrically opposite in the direction of *O* to *B*. In the same manner, as *H* approaches *A*, *E* will approach *B*, and so on. Thus it will be plainly seen that this armature will not be pulled from side to side, thus giving a constant, steady torque, avoiding any rattling on the bearings.

The Electrical Exhibition.

The early selling of space at the Electrical Exhibition, which will be held at Madison Square Garden, New York, next May, is taken by the managers to augur well for the success of the enterprise. They state that the space already contracted for exceeds by one-third the total space sold at the 1896 show, and that the increase in the demand for space is larger in proportion than the increase in space afforded at the Garden, as compared with that available at the last show. If the demand is maintained at this rate Madison Square Garden, with its immense area, will be none too large for the exhibition. In the operative section there will likely be three batteries of boilers, against one at the last exhibition, and the dynamo and engine exhibit will probably be enlarged at the same ratio.



PLAN OF MADISON SQUARE GARDEN.

The accompanying illustration gives a plan view of the amphitheatre and arena circles at Madison Square Garden. The operative exhibits will be placed in the basement.

The "O. K." Dry Battery.

That there is a large field of usefulness for the dry form of battery is evident from the great number of different makes that have been placed upon the market in the past. In the manufacture of dry batteries, as in most all other articles of commerce, good, bad and indifferent results have been produced, and it is gratifying to know that good ones can be procured if it is only known where to look for them.

The "O. K." battery, manufactured by the Non-Polarizing Dry Battery Company, 625 Broadway, New York City, it is stated, not only excels all forms of sealed dry batteries, but proves itself equal to all and superior to many of the various forms of sal-ammoniac batteries. This particular make of cell bears every evidence of being constructed substantially, with the view to obtaining from it a large output for the longest possible period of time. In its construction the materials and chemicals used are the best and purest, and these are said to be combined in a manner radically different from the methods employed in the construction of other dry batteries.

Among the advantages claimed for the "O. K." cell are: reduction of polariza-

tion to a minimum, practical freedom from local action, great recuperative power and high voltage and amperage. The "O. K." cell is made in five sizes, ranging from 1½ by 4 to 3 by 7 inches. Its E. M. F. is 1.5 volts, and the internal resistances vary between .15 of an ohm and .3 of an ohm

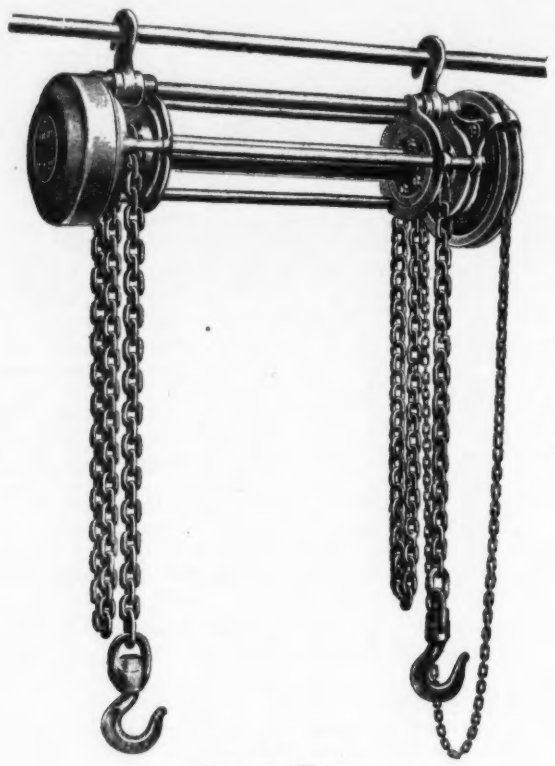
Prof. F. B. Crocker, of Columbia University, tested five (type B) cells, and his report of the results is a virtual testimonial to the excellence of the battery. One of the cells maintained a voltage of 1.1 volts and .22 of an ampere for eighty-eight hours. Another cell started with a current of .55 of an ampere, and gave an average power of .413 watt for forty-eight hours, or about 18.2 watt hours. The curves showed that the battery would have continued to give current for a considerable time after test was stopped. Even after running the battery for eighty-eight hours, and obtaining twenty watt hours from it, it was found that the volts rose to 1.33 after a rest of forty-eight hours, showing that the battery had recuperated almost to its original voltage, and still contained considerable energy. Prof. Crocker expressed his surprise to find a dry battery which gave such a large output and maintained it with fair constancy for so long a period of time.

Some very large concerns of this country, including the Pennsylvania Railroad Company, Pullman Palace Car Company, New York Central & Hudson River Railroad Company, Central Railroad of New Jersey, Long Island Railroad, Otto Gas Engine Works, Philadelphia; the Pierce Engine Company, Racine, Wis., and many others are liberal users of the "O. K." battery.

Special Triplex Hoist.

The accompanying illustration shows a special form of the Weston Trip'ex Chain Block, made by the Yale & Towne Manufacturing Company, Stamford, Conn., and 84-86 Chambers Street, New York, especially designed for handling long material, such as bars, beams, lumber, etc.

It consists of a triplex block, with its mechanism separated into two parts, coupled by means of shafts and separators, and provided with two hoisting chains, the combined strength of which is equal to the lifting power of the



Triplex Hoist.

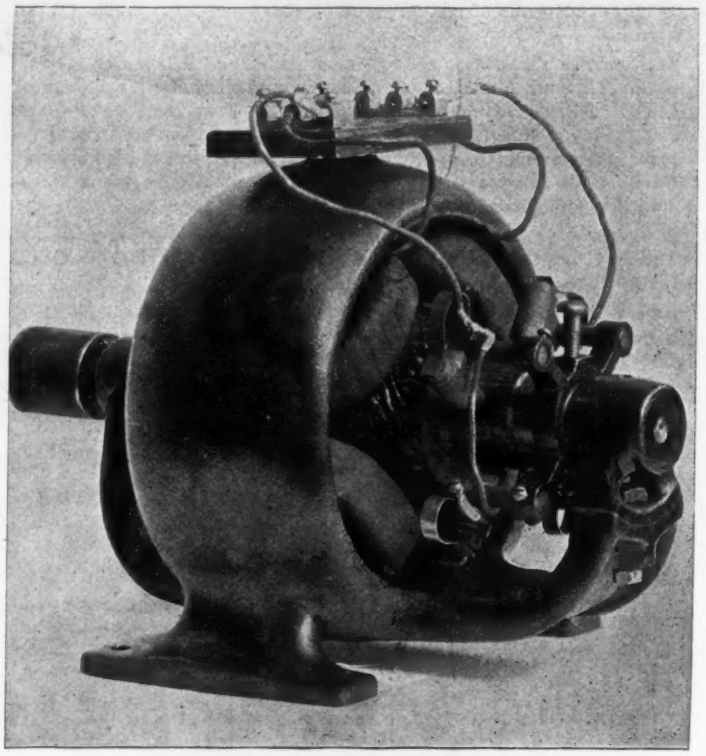
block. The hoist can be so built as to separate the two hooks any distance desired, according to the character of the material to be handled. It may be hung from a fixed support, as in the illustration, or from a trolley on an overhead track or crane, as desired.

The hoist thus provided with two lifting chains and hooks always moving together is adapted to a wide range of uses, and for the handling of long material is much better than a block with a single lifting chain. The latter is sometimes used with a yoke having hooks at each end, but this arrangement is less steady than the one shown in the illustration, and necessarily occupies much more head room. The triplex hoist, with two lifting chains, will doubtless commend itself for a wide variety of uses.

A Machine for Students of Electricity.

The illustration shows a new design of a dynamo for experimental purposes manufactured by the Institute for Home Study of Engineering, Cleveland, Ohio, for its students. It is a high-grade commercial machine, adapted to experimental work, the idea in furnishing such a machine being that after the student has finished his course he can use it for ordinary and any work. When the student reaches that part of his course treating of dynamo construction he receives the machine with every part finished and with all the materials for winding, *i. e.*, making the armature complete, putting on and connecting the field coils. This work is a part of the electrical course of the institute. When completed, the student uses the machine experimentally during the remainder of his course.

The illustration shows the machine complete. The armature is of the drum type, with laminated core. The commutator is long, in order that the collector rings for taking off currents uncommuted, in from one to four phases, may be



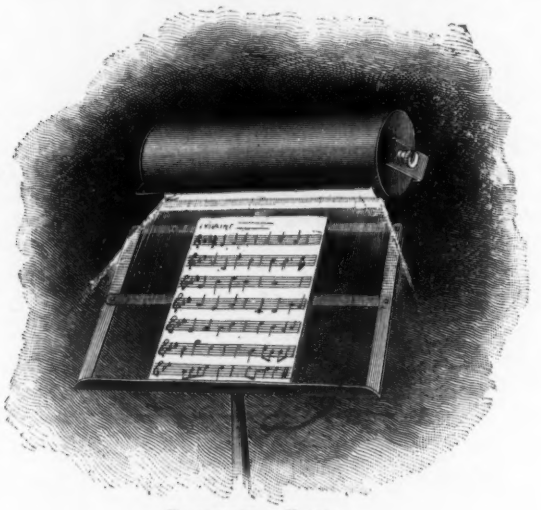
Electric Machine for Students of Electricity.

slipped on it, together with the new set of brushes required. When operated as an alternating current machine it excites its own fields.

The range of experimental use is wide. The machines built by the Institute have, it is stated, been found to be so well adapted for instruction purposes that they are now in use in a number of schools and colleges. The teachers of electricity find that the practice of winding and connecting the machine is of great value to the students. A full description of the process of winding accompanies the machine when sent to technical schools.

An Orchestra Lamp.

The accompanying illustration represents the new "Ward Orchestra Lamp," which has just been placed upon the market by Messrs. McLeod, Ward & Co., 27 Thames Street, New York. It is cylindrical in shape, the socket being inside the cylinder, which is pivoted on the ends and may be revolved in any direction.



Orchestra Lamp.

The cylinder is composed of two pieces, one of which revolves inside the other, so that any desired opening may be obtained, depending on volume of light required. This device, although called an orchestra lamp, is just as serviceable for lighting pulpits and pictures. The rector of St. Thomas' Church, New York, it is stated, experimented with several devices for lighting his pulpit, but did not find anything satisfactory until the Ward orchestra lamp was installed. The lamp is fitted with an adjustable clamp for attaching to music racks. The standard fixture is made to take a 16-cp lamp.

NEWS OF THE WEEK

Financial Intelligence.

THE COMMERCIAL CABLE COMPANY has declared a quarterly dividend of 1¾ per cent. and bonus of 1 per cent., payable January 1, 1898.

STREET RAILWAY EARNINGS.—The Columbus Street Railroad reports gross earnings for November of $49,747, an increase of $1,710, as compared with the same month of last year, and net $26,303, an increase of $2,010. The North Shore Traction Railroad reports gross earnings for October of $122,284, an increase of $10,458, as compared with the same month of last year, and net $50,395, an increase of $5,511.

THE WESTERN UNION TELEGRAPH COMPANY has declared a quarterly dividend of 1¼ per cent., payable on January 15. The company's report for the quarter ended December 31 (partly estimated) shows net revenues of $1,600,000, an increase of $54,546, as compared with the same item for the corresponding quarter last year. Interest on bonds $224,500, a decrease of $18,859, leaving a balance of $1,375,500, an increase of $73,405. Deducting dividend of 1¼ per cent., amounting to $1,216,975, leaves a surplus of $158,525, which, added to previous surplus, gives a total surplus of $8,068,527, an increase of $162,486.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 11, 1897.

STRIKE OF ELECTRICAL WORKERS.—About 500 of the 1200 hands employed by the Western Electric Company in this city struck work last week because of a new piece-work system. It is reported that the Electrical Appliance Makers' Union, which is a local assembly of the Knights of Labor, proposes to extend the strike by calling out 700 more employees. An effort will also be made, it is stated, to carry the strike to the company's Chicago factory, and that the agitation may spread to the Antwerp, Paris, Berlin and London works.

THE NEW YORK ELECTRICAL TRADE SOCIETY held its annual meeting at the Astor House on December 7. About four-fifths of the membership was represented. The work of the society during the year has been so successful that steps are being taken looking to the enlargement of its scope. With a view to increasing the membership the initiation fee was reduced from $50 to $10. This makes the fee of the New York society uniform with that of similar societies in other cities. The same executive committee which managed the society's affairs last year was unanimously re-elected.

THE RULES ON INSULATION adopted by the Board of Fire Underwriters last December were adopted by the committee of the Underwriters' National Electrical Association, at a meeting held in this city on December 8. The suggestion of endorsing specific appliances came up at the same meeting. and it was thought by some of those present that it would be a good plan to recommend those that had stood the test. It was finally determined to ask for all articles and electrical appliances that had been satisfactorily tested and list them without any specific recommendation. A committee was chosen to confer with the New York Fire Department to harmonize the rules as to insulation, etc.

BROOKLYN FRANCHISES VETOED.—Mayor Wurster, of Brooklyn, has vetoed all the franchise resolutions recently adopted by the Board of Aldermen and still before the courts in injunction proceedings. The grants included one of over 25 miles of new trolley lines to the East River & Atlantic Ocean Railway Company, and one permitting the Municipal Electric Company and the Flatbush Gas Light Company to extend their operations to the entire city. In his veto of the trolley franchise Mayor Wurster says: "There is no pretense that the roads now operated do not afford adequate facilities for transportation through the different sections of the city. Under such circumstances, there is no justification for placing additional burdens upon the streets of the city in the shape of car tracks and overhead electrical constructions for the operation of cars over the same."

THE ELECTRICAL EXHIBITION COMPANY on December 6 gave a pleasant little dinner at the Arena, on Thirty-first Street, to the electrical journalists. Mr. H. H. Harrison, chairman of the executive committee; General Manager Marcus Nathan, Secretary George F. Porter, and Mr. C. A. Lieb, explained the scope of the forthcoming exhibition, which will be held at the Madison Square Garden during the month of May, 1898. After thanking the newspaper men for what they had done toward the success of the 1896 exhibition, they said that from the present outlook they felt that even more flattering things will be recorded of the 1898 exhibition. The work for the coming exhibition, it was added, was well advanced, and the general opinion was that the display made would be one in every way creditable to the various electrical industries.

ELECTRIC GIG FOR THE CZAR OF RUSSIA.—The Electric Launch Company, Morris Heights, this city, is constructing an electric gig for the Czar of Russia, to be used as a tender to one of the Czar's yachts. It will be ready for shipment about April 15 next. The dimensions of the craft are—length over all, 37 feet; beam, 7 feet 3¾ inches; draught, 2 feet 1 inch. The electrical equipment will represent the highest development in this line. The accumulators will be placed, as usual, under the flooring and seats, and will be so arranged as to be easily connected to a source of electrical supply on land for the purpose of charging. The motor will be of the special marine type, with thrust ball bearings. The controller for regulating the speed of the motor will be operated by a shaft extending through the steering wheel. It will effect five variable speed rates, and is also adapted for reversing the motor with three variable speeds. The accumulators will have a capacity sufficient to drive the boat 8 miles an hour for three hours, or 7 miles an hour for six hours.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 630 Atlantic Ave.,
BOSTON, Mass., Dec. 11, 1897.

THE FIFTH ANNUAL OYSTER ROAST given by the Berlin Iron Bridge Company to its employees and their families will take place at the company's works in East Berlin, Conn., on the evening of December 15.

THE WEST END LEASE.—A special meeting of the stockholders of the West End Street Railway Company was held in this city on December 9, to consider the question of leasing the company's property to the Boston Elevated Railroad Company. In order to meet the objections which were recently raised by the Board of Railroad Commissioners, the directors carefully considered the subject, and agreed upon a form of lease in which certain concessions have been made. The important changes are in the rate of dividend on the common stock from 8 to 7 per cent., and the term of lease from ninety-nine years to twenty-four years, nine months, ten days. The stockholders, by a vote of 199,652 shares, authorized the execution of the lease of the company's property and franchises to the elevated road; 2874 shares were cast against the proposition.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Dec. 10, 1897.

MANAGER OLIVER WATSON, of the Automatic Telephone Company, a local concern, states that he is not yet prepared to introduce his system here. This announcement is looked upon as indicating that there is some understanding with the Bell Company.

MUNICIPAL OWNERSHIP is engaging the attention of the people of Tonawanda just now, and they are taking steps looking in that direction, with reference to the electric lighting system of the town. Most of the trustees, it is stated, are in favor of the idea.

THE BUFFALO GENERAL ELECTRIC COMPANY is making preparations to change its headquarters from the present locality on Fourth Street to its station on Wilkeson Street. The company, it is stated, will install a storage battery plant at the Wilkeson Street station.

NEW TRANSFORMERS.—As soon as they can be procured the Niagara Falls Transmission Company will install new transformers at the new transformer house on the water front to take the place of the present apparatus, which was put in temporarily. The new transformers will be water-cooled.

THE UNION DRY DOCK COMPANY, which will utilize some of the Niagara power, has had a small current brought to its works for the purpose of enabling it to determine how much electrical energy will be needed. Motors have been attached to each machine, and the horse-power necessary to drive them will be determined. When the test is completed the apparatus will be ordered.

PITTSBURG NOTES.

PITTSBURG, Pa., Dec. 10, 1897.

EARNINGS STILL INCREASING.—The Consolidated Traction Company reports for the month of November gross earnings amounting to $167,770.86. This is an increase of $18,481.89 over the corresponding month last year.

DIVIDEND DECLARED.—The Allegheny County Light Company has declared its regular quarterly dividend of 1½ per cent. payable on December 31, to stockholders of record December 8. Transfer books will be closed until December 31.

THROUGH CARS TO WILKINSBURG NOW IN OPERATION.—The reconstruction of the Consolidated Traction Company's road bed in Wilkinsburg has progressed so far that the cars from the city, which formerly stopped at the borough line, now run through, so that Wilkinsburg passengers can now travel to and from the city without transfer. The through cars are now running on both the Penn Avenue and the Hamilton Avenue lines.

WRIT OF QUO WARRANTO REFUSED.—Although the official announcement has not yet been made, it is reported that the Attorney-General has refused the application of the Allegheny County Light Company for a writ of quo warranto against I. Jackson & Brother, to determine by what right this firm furnishes electric light to some of its neighbors. The ground upon which the

Attorney-General bases his refusal of the application is that he has no jurisdiction in proceedings against private individuals.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has received advices from Glasgow to the effect that the municipality of that city has awarded it the contract for equipping the tramways and power houses in that city with its apparatus and machinery. The Glasgow tramways are 70 miles in length. The Glasgow commissioners were in this country last year inspecting American street railway lines. The Westinghouse Company has also received a contract for a street lighting plant for Malaga, Spain.

NO MUNICIPAL PLANT FOR CUMBERLAND.—Last May a bond election was held by the citizens of Cumberland, Md., which authorized an issue of bonds to the amount of $20,000 for the purpose of building an electric light plant for the purpose of lighting the streets. An engineer was employed to draw up plans and specifications for the proposed installation, and bids for the plant were received on November 15. After considering all the proposals and carefully canvassing the situation the Council decided to reject all bids, and to enter into another contract with the Edison Electric Illuminating Company, of Cumberland. This company therefore will continue to light the streets, as before.

UNIONTOWN BUSINESS MEN WANT COMPETITION IN LIGHTING.—The United Light Company, which is engaged in the electric lighting business at Uniontown, Pa., has notified the Fayette Gas Fuel Company to stop furnishing natural gas for illuminating purposes. The gas company accordingly fixed December 1 as the date for shutting off such of its customers as refused to stop using the natural gas for lighting purposes. Some of the business men, however, stepped in and secured a preliminary injunction restraining the United Light Company from compelling the gas company to abandon the sale of natural gas for illuminating purposes. The outcome of the fight is awaited with much interest at Uniontown.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Dec. 10, 1897.

AT THE LAST MEETING of the Chicago Electrical Trade Association Mr. F. S. Terry was unanimously elected president, and Mr. James Wolff vice-president.

THE SUNBEAM INCANDESCENT LAMP COMPANY, of Chicago, has recently established a branch office in New York, and placed it in charge of Mr. A. S. Terry.

THE EDISON COMPANY last week closed a contract with the Electric Storage Battery Company, Philadelphia, Pa., for a storage battery plant, to be installed in the basement of its Adams Street station. The battery will have a capacity of over 11,000 ampere hours, and will be, it is stated, the largest individual plant that has ever been installed in this or any other country.

THE ENGLEWOOD ELECTRIC LIGHT COMPANY has passed into the control of interests which are understood to be identical with those owning and operating the Calumet Gas Company and the Hyde Park Electric Light & Power Company. The transfer of the property leaves this combination practically without a rival in the electric lighting business in that territory of the city south of Thirty-ninth Street, and extending from the lake to Englewood.

THE SIEMENS & HALSKE ELECTRIC COMPANY expects to ship about February 15, 1898, to the City of Mexico, the electrical plant which is to be used to light that city. The plant will have a capacity of 40,000 incandescent lights and 600 arc lights, and most of the apparatus and supplies, including the poles, have been sent from this country. It is stated that the Siemens & Halske Company is also engaged in filling contracts for electric lighting plants for other parts of Mexico.

THE PLANT OF THE CHICAGO ILLUMINATING COMPANY has passed into the hands of the Edison Iluminating Company. It will be shut down, and its service of about 500 arc lamps transferred to the Edison stations. The company's business represented the combined efforts of three small enterprises, which have been in operation on the south side of the city for several years. The company had an authorized capitalization of $500,000, and it is stated that the actual investment amounted to $250,000. The purchase price, however, was only about $110,000, while the acquisition is understood to be worth between $15,000 and $18,000 a year to the Edison Company.

Milwaukee Notes.

MILWAUKEE, Wis., Dec. 10, 1897.

THE MAIN OFFICE of the Postal Telegraph-Cable Company in this city is being moved to 100 Michigan Street.

AN ELECTRIC RAILWAY between Oshkosh, Wis., and Neenah is planned. James K. Tillotson, secretary of the Citizens Traction Company, is at the head of the movement. The road will not, however, be connected in any way with the Neenah and Appleton road.

AGITATION FOR BETTER LIGHT.—The Council committee on street lighting will recommend that hereafter all night patrolmen shall report to the central station all street lights that are out or burning dimly, the central station to report to the Milwaukee Electric Railway & Light Company. The action is the result of complaints made by South Side residents.

THE PFISTER VOGEL LEATHER COMPANY is enlarging the electric power plant at its Bay View tannery. A 60-kw direct-connected unit will be added. The satisfactory results obtained from this plant led the company to equip the Cheboygan tannery at Cheboygan, Mich., with electric power. A 75-kw belted generator will furnish power to motors aggregating 95½ horse-power.

St. Louis Notes.

ST. LOUIS, Mo., Dec. 9, 1897.

THE BELLEVILLE ELECTRIC RAILWAY COMPANY will ask the Belleville Council for a franchise for a double track through that city in order to avoid delay in the running of cars, when the line to East St. Louis is in operation.

COMPETITION IS SHUT OFF.—The Board of Public Improvement has recommended that the new city lighting contract shall be let to an electric light company for a term of fifteen years, beginning January 1, 1900. The electric light ordinance has passed the first reading in the City Council.

THE FINAL DETAILS of the consolidation of the Missouri and Edison Electric Light Companies will be completed within a few days. Some time ago the stockholders of the Edison Company turned over their shares and in return will receive about December 15 a $500 bond and five $100 shares of preferred stock in the new company in return for each $1000 of stock in the old.

NEW ELECTRIC RAILWAY.—Within a short while East St. Louis will have electric roads in several directions. There are now two under course of construction between this town and Belleville. Another is proposed to run from East St. Louis and Vincennes, Ind. A right of way is now being secured. The old right of way of the St. Louis & Vincennes Railroad will be secured. It is said the promoters are having no difficulty in securing the right of way through the farm lands. The company was incorporated a few weeks ago.

THE KINLOCH TELEPHONE COMPANY will be ready to open its exchange by August 1, 1898. If it desires to do so by that time it will be able to connect its lines with 5000 miles of long-distance wires. It is now considering the proposition. To date it has secured 5180 'phones, of which 3140 are business houses and 2040 residences. In East St. Louis it has 440 'phones. The company furnishing the best and cheapest service will succeed. In many houses the Bell and Kinloch telephones will be operated side by side, and ample opportunity will be afforded to thoroughly test the service rendered by each.

Southwestern Notes.

SAN ANTONIO, Texas, Dec. 7, 1897.

ARTICLES OF INCORPORATION of the Dallas Ice Factory, Electric Light & Power Company have been filed with the Secretary of State at Austin. The capital stock is $100,000. The directors are: Charles J. Ball, J. T. Armstrong and D. C. Ball, all of Dallas.

THE CONSTRUCTION OF A NEW TELEPHONE SYSTEM in Prescott, Ark., will soon begin. The name of the company is the Southwest Arkansas Telephone Company, and the incorporators are: W. C. Wingfield, C. B. Gale and J. T. Abraham. The capital stock is $5,000.

THE MAYOR OF SAN ANTONIO has vetoed the franchise which the Council granted to the Merchants & Manufacturers Transportation Company for an electric freight railway line. It is reported that the franchise will be amended so as to meet with the mayor's approval, and again passed.

THE ALTHEIMER LONG-DISTANCE TELEPHONE COMPANY, of Pine Bluff, Ark., was incorporated a few days ago. The capital stock is $25,000, with $10,000 paid up. The line of this company now runs from Swan Lake to Pine Bluff, and will be immediately extended to Altheimer and Little Rock.

THE NEW TELEPHONE EXCHANGE at El Reno, Okla., was opened on November 19. The company has just completed a telephone line to Fort Reno and to the Cheyenne and Arapahoe Indian Agency at Darlington, Ind. Ter. The company expects within a month to put in a line to Oklahoma City and on to Guthrie, and early in the year to extend north from Guthrie to Newkirk, completing the circuit to Wichita and Kansas City.

THE EXTENSIVE COAL MINES at Thurber, Tex., owned by the Texas & Pacific Railway Company, are lighted throughout with electricity. A complete trolley system is now being installed in all of the underground tunnels, and the coal cars fitted up with motors. In a short time the patient mule will be relegated to the past, and electricity used exclusively in the propelling of the coal cars in all parts of the different mines. The capacity of the mines is 2000 tons per day.

TAXING POLES.—An ordinance has been introduced in the City Council here, which provides for the taxing of all telegraph, telephone, street railway and electric light poles within the limits of the city. The passage of the ordinance is assured. The companies affected by the measure are preparing to fight it to the end. They will all refuse to pay the tax on the ground that it is unconstitutional. A test case will be made and a decision obtained on the point of law from the higher court.

THE ELECTRIC LIGHT AND STREET RAILWAY PLANTS at the border towns of Laredo, Tex., and Nueva Laredo, Mexico, are, it is reported, to have important improvements added to them, and a strong effort is to be made to improve the service. The electric street railway system which was built in Laredo, Tex., and extended across the river, by way of the International Bridge over the Rio Grande, has had many serious difficulties to contend with during the past several years, and was in the hands of a receiver for some time.

Mexican Notes.

MONTEREY, Mexico, Dec. 7, 1897.

REMOTE SECTIONS OF MEXICO are being rapidly given communication with other parts of the country by the establishing and extension of telephone lines. It is announced that a telephone line has been completed between the port of San Benito, in the State of Chiapas, and Tapachula.

EXTENSIVE IMPROVEMENTS have been made in the electric light system of the city of Zacatecas recently. These improvements were made

directly through the instrumentality of General Jesus Arechiga, Governor of the State of Zacatecas. Governor Arechiga has progressive ideas as to both State and municipal affairs.

A NEW GOVERNMENT REGULATION concerning telegraphic addresses went into effect in Mexico on November 1. The new law requires all business houses in the interior of the republic, using a single name as a cable address, to register the same in the Direccion General de Telegrafos Federales in the City of Mexico, and pay $10 per annum for this registration.

THE POSTAL TELEGRAPH COMPANY'S SERVICE between El Paso, Tex., and the City of Mexico is over a new heavy copper wire which was recently strung by Capt. George C. Sperry, superintendent of the telegraph system of the Mexican Central Railroad. The distance is 860 miles. This new wire permits the use of the quadruplex system throughout the entire length of the line.

IT IS NOW ANNOUNCED that the company which is building the railroad from Jalapa to Cordoba, in the State of Vera Cruz, has abandoned the idea of making it an electric line, owing to the expense of equipping and operating it. This announcement comes as a surprise, as it was reported some time ago that the electrical equipment for the road had already been purchased in the United States.

A NEW ELECTRIC RAILWAY IN THE FEDERAL DISTRICT.—It is stated that the preliminary plans have been completed for the building of an electric railway between the towns of San Ildefonso and Tlalnepantla, situated in the Federal District. San Ildefonso is a thriving manufacturing centre, and the railway will be used for both freight and passengers. Water power will be used for the operation of the line.

A NEW ELECTRIC LIGHT PLANT is being established in the city of Jalapa. It will furnish both light and power. It is reported that the street railway system of Jalapa is to be converted into electric lines, and that the new company will furnish the electric power. It is said that the power for the operation of the electric light plant and the street railway system will be derived from the Tiocelo River, and that three Pelton wheels, utilizing in the aggregate 1200 horse-power, will be set up, although 2000 horse-power are available from the river.

IMPORTS OF ELECTRICAL APPARATUS.—It is shown by the official reports of the different custom houses of this country that there has been a great decrease in the importation to this country of foreign electrical machinery since the decline in silver several months ago. A considerable quantity of electrical machinery continues to be brought into this country from the United States, despite the high rate of exchange, but it is principally for use in the mines. Two of the leading iron foundries of Mexico are making preparations to manufacture certain classes of electrical machinery, and, in fact, they are already manufacturing some kinds, but in a very limited way.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Dec. 8, 1897.

MR. BEN. E. DAVIS, traveling representative of the Electric Gas Lighting Company, of Boston, has just left for Los Angeles, after spending a month in this city in the interests of his company.

THE WESTERN UNION TELEGRAPH COMPANY'S new copper wire from this city to Chicago has just been put into use. The line was constructed in sixty days, at a cost of $200,000, the distance covered being 2,000 miles. The company's new wire from Seattle, Wash., to San Francisco, will be completed by the end of the year.

THE YUBA POWER COMPANY, which will supply electric power in the Brown's Valley mining district, and lights in Marysville, Cal., has closed a contract with the Pelton Water Wheel Company, of San Francisco, for three 700-hp impact wheels, which are to be directly connected with three Stanley two-phase generators. The plant is to be in operation March 1, 1898.

THE PACIFIC COAST TELEPHONE COMPANY has been incorporated for the purpose of maintaining a telephone exchange in Santa Cruz, Cal., and extending the system into adjoining countries. The capitalization is $25,000. The capitalists of San Francisco, San José and Santa Cruz, who own the stock, will purchase the property and franchise of the Popular Telephone Company.

THE MUTUAL ELECTRIC LIGHT COMPANY, San Francisco, recently completed the installation of additional series arc machines having a capacity of 300 lights and alternating generators of 8000 incandescent light capacity. Also two additional Thompson-Corliss tandem compound engines, 18 and 31 by 48 inch stroke, built in San Francisco; also a 200-kw, 220-volt, direct-current generator. The generators were supplied by the Fort Wayne Electric Corporation, through its San Francisco agency. The company has greatly extended the territory covered by its underground system, and has installed a 220-volt power system for operating motors, etc. Two 400-kw Fort Wayne alternators are in use, operating incandescent lights and about 400 alternating arc lamps.

ALLEGED BETRAYAL OF TRUST.—The advisory jury in the case of the California Electric Light Company vs. the executor and executrix of George H. Roe's will recently rendered a verdict, which, if sustained, will bring a large sum to the plaintiff. The verdict stated that there was a secret agreement between George H. Roe and Charles R. Lloyd by which, in consideration of his services in procuring the California Electric Light Co. to vote Charles R. Lloyd a commission of 1000 shares of the Edison Light & Power Company, George H. Roe should receive one-half of the commission. It was also found that Roe, although a director in the California Electric Light Company, received one-half of the commission which Lloyd had been allowed for his services in promoting the organization of the Edison Light & Power Company, and the purchase by it of the plant of the California Electric Light Company. These facts having been proved, Roe's estate is mulcted for a division. The corporation claims that Roe betrayed his trust as a director, and it is now endeavoring to recover the stock which he received, or its equivalent value, with accrued dividends. The estimated value of the 500 shares, with dividends added, is about $75,000.

CANADIAN NOTES.

OTTAWA, Ont., Dec. 11, 1897.

STRATFORD, ONT.—The City Council have decided to call for tenders for a street-railway franchise.

WOODSTOCK, ONT.—A project is mooted to build an electric railway between this city and Ingersoll. Toronto capitalists are said to be interested.

NAPIERVILLE, QUE.—The town of Napierville and the parish of St. Cyprain have voted a bonus of $10,000 to the Southern counties electric railway scheme.

ST. THOMAS, ONT.—The City Council has decided to submit a by-law to the ratepayers to guarantee the bonds of the street railway to the amount of $50,000 in consideration of the road being converted into an electric road.

VERNON, B. C.—A franchise has been granted to the Cascade Water Power & Light Company, composed of Rossland and Spokane capitalists, who will build an electric railway through the lower country, and furnish electric light and power.

SMITH'S FALLS, ONT.—Application will be made at the next session of the Ontario Legislature to incorporate the Smith's Falls, Rideau & Southern Electric Railway Company, with power to operate electric railways within the counties of Lanark, Leeds and Greenville; also to construct telegraph and telephone systems.

DARTMOUTH, N. S.—It is probable that a New York syndicate will purchase the present electric-light plant, and make extensive improvements, including the erection of a generating station at Fall River. The proposed improvements will cost about $100,000. Mr. C. R. Corsant was recently in town in connection with the project.

THE DOMINION ELECTRICAL HEATING COMPANY intends to commence the manufacture of its patent heaters on an extensive scale in Ottawa during the next few weeks. The company is now fitting up for its contemplated operations. The electric heater to be manufactured is one invented by a resident of this city, and the heater, which is comparatively inexpensive, is said to give astonishing results.

APPLICATION HAS BEEN MADE to the Ottawa City Council by the Deschenes Electric Light Company, asking permission to do a general light, heat and power business in Ottawa. It has connection with Ottawa through a submarine cable from the Hull side, and is now furnishing power to some particular concerns in the city. The company proposes to use underground wires in the residential and business portions of the city. There is some doubt as to the application being granted at present.

THE NOON SIGNAL GUN at the Parliament buildings in Ottawa is shortly to be fired by electricity direct from Montreal each day. The reason for this is that on account of the complicated and indirect method now in vogue for transmitting the time signal from the observatory at Montreal to the firing station here the correct time cannot be ascertained by the gun. The plan now under consideration of the Marine Department provides for the firing of the cannon direct by means of an electric fuse. Instead of the ordinary telegraph battery hitherto employed to drop the time-signal ball it is proposed to utilize the low voltage current of the city incandescent lighting system. A few minutes before 12, noon, the fuse will be inserted in the loaded gun, and the wires connected at the signal house with the Montreal line. Upon the hour, the operator at the Montreal observatory will press an ordinary telegraph key, closing the circuit and instantly discharging the gun.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Dec. 1, 1897.

UNDERGROUND TELEPHONE WIRES IN THE CITY OF LONDON.—A case of considerable interest has just been heard in the City of London Court. It will be remembered that the City Commissioners of Sewers, which is the body who have sole control of the streets in the city of London, refused to grant the National Telephone Company permission to lay telephone wires underground, unless the company would considerably diminish its rates of rental to subscribers in the city. In the case of some of their junction wires, however, the National Telephone Company profiting by a clause in the recent agreement made with the Postmaster-General at the time of the Government taking over the trunk system, rented some underground wires originally laid for telegraphic purposes by the post office authorities. A few months ago on the post office applying to the Commissioners of Sewers for leave to open up the streets to lay a new line, the latter stipulated as a condition of their granting this permission, that the Postmaster-General should undertake not to rent these wires for telephonic purposes. The post office naturally refused to have any conditions imposed, and deeming that " a difference has arisen under the telegraph act of 1878," applied in the City of London Court for the necessary consent to open up the streets without conditions. The case has been argued to-day at considerable length, and as a result the consent was given and the conditions set aside. Unfortunately this decision will only apply to a limited number of telephone lines in the city. The National Telephone Company will still be unable to use underground conductors for their subscribers' lines in this part of London. The majority of the present underground lines rented from the post office are for connection between the company's exchanges and the office at which the post office trunk lines branch out.

THE SECOND ANNUAL MOTOR CAR MEET.—The second annual meeting of the Motor Car Club took place on Monday last at Whitehall Place, outside the Hotel Métropôle. About forty-three motor-propelled vehicles of various kinds assembled between 11 and 12 o'clock, when the signal was given for a start to Richmond. The day, though very cold, was fine, and the roads were in fairly good condition. I had the good fortune to secure a seat on one of the few electrically propelled vehicles that took part in the procession, this being the new car recently brought out by the Headland's Storage Battery Company. The route taken involved ascending one or two somewhat steep hills, which

proved rather trying to some of the frailer of the oil propelled craft, the riders on these being subjected to a running fire of criticism and boisterous laughter on the part of the crowd that lined the roadway. One of the vehicles, which early broke down, was a curious combination of a tricycle and chaise, driven by an oil engine. The driver sat on a saddle in the front part of the vehicle, and occasionally assisted the engine by pedalling, while two somewhat corpulent individuals took up a position in the chaise behind. The vehicle proceeded as far as the first hill, viz., about 100 yards from the starting point, when it was brought to a full stop, and, the passengers being compelled to alight, the driver had to convey the vehicle, chiefly by pedalling, over the rest of the journey. Breakdowns of this sort, however, were the exception rather than the rule, and it is noteworthy that everyone of the forty-three motor cars arrived safely, and in the majority of cases in excellent time, at the destination, viz., the cycle track, Sheen House, Richmond. As far as the electrically propelled cars are concerned, these made a very excellent show. There were among the number the now familiar electric cab of Mr. Bersey's and the Headland's car, this latter performing the distance from Whitehall to Richmond in about fifty minutes. At Richmond a number of motor cycle races took place, at the end of which a start was made for home. The return journey was made at a very rapid pace, the distance from Richmond to South Kensington station being made by the Headland's car in about twenty-five minutes, involving a speed which must have taxed the toleration of the police authorities. In the evening a banquet was held at the Hotel Métropôle, and a very clever speech was made by Mr. Harry Lawson, the president of the Motor Car Club. Mr. Lawson observed that in the future ages people would look back with scorn on the nineteenth century as a time when speed was a crime, and when the slow people put other people in prison for going faster than themselves. He said he did not object to the horse as a horse, but when it tried to become a motor it really became an infringement of the motor car syndicate's patents, and was not very successful at that. Altogether this second annual procession of motor cars is much more favorable to the industry than the first, which your readers will remember took place last year in stormy weather on the road between London and Brighton. A notable point is the improvement made by the electrical motor cars, which from occupying an insignificant place, are now standing in a very prominent position. Electrical engineers in this country are congratulating themselves, for notwithstanding the boom that has been made with oil-driven and steam-driven motor cars, none of these have yet appeared commercially as public vehicles, while the electrical cabs, which are now running about London, give every promise of a financial success.

General News.

New Incorporations.

THE WATERVILLE & FAIRFIELD ELECTRIC LIGHT COMPANY, Waterville, Me., has been reorganized, and the plant will be improved. Hon. P. C. Libby is presient.

THE STANDARD ELECTRIC LIGHT, HEAT & POWER COMPANY, Avoca, Pa., has been organized. The incorporators are Arthur H. Squires, F. J. Jordan and others.

THE M'LEAN COUNTY TELEPHONE COMPANY, Bloomington, Ill., has been formed, with a capital stock of $50,000. The incorporators are: Harry S. Bower, E. R. Bower and Frank Y. Hamilton.

THE ELECTRO-MOTO SIGN COMPANY, of San Francisco, was recently incorporated by John L. Cahill, Joe E. Shearer, Jason W. Nash and S. W. Robertson. Capital stock, $500,000; actually subscribed, $500.

THE BELLEVILLE TELEPHONE COMPANY, Belleville, Kan., has been organized, with a capital stock of $5000. The directors are H. L. Pierce, D. D. Bramwell, J. M. Doyle, J. C. Dawson and W. T. Perry.

THE LEBANON ELECTRIC LIGHT COMPANY, Lebanon, Ohio, has been incorporated, with a capital stock of $26,000. The incorporators are: L. W. Newcomer, C. C. Stickelman, F. C. Work and W. G. Thompson.

THE PENNSYLVANIA ELECTRICAL COMPANY has been organized at Marietta, Pa., to manufacture telephones and other electrical appliances. Charles Engert, of New York City, and E. L. Reinnold, of Marietta, are interested.

THE CITIZENS ELECTRIC LIGHT, POWER & HEATING COMPANY, Middletown, N. Y., has been organized, with a capital stock of $25,000. The incorporators are Clarence S. Adams, U. T. Hayes, C. R. Fuller and others.

THE DELAWARE TERMINAL RAILROAD COMPANY, Franklin, N. Y., has been formed for the purpose of building an electric railroad from this place to Sidney. The main office will be located at Sidney. Capital stock, $150,000.

THE HARRIMAN ELECTRIC SPECIALTY COMPANY, Hartford, Conn., has been organized, with a capital stock of $5,000, to manufacture electrical instruments. The stockholders are H. W. Fox, T. J. Blake, F. H. Harriman and others.

THE MIDDLETOWN & PORTSMOUTH RAILROAD COMPANY, Newport, R. I., has been incorporated, with Congressman Bull as president. The company proposes to build an electric railway through the towns of Middletown, Portsmouth and Tiverton, etc. The capital is $200,000.

THE OTTUMWA TELEPHONE COMPANY, Ottumwa, Ia., filed articles of incorporation with a capital stock of $40,000. The incorporators are George H. Cowdrey and F. S. Turner, of Geneva, Ohio; J. C. Goddard and Cyrus Martin, of Unionville, Ohio, and Edwin A. Knapp, of Ottumwa.

THE AMERICAN MOTOR WAGON COMPANY, Portland, Me., has been incorporated to manufacture dynamos, batteries and other electrical appliances. The incorporators are: Henry N. Bates, Hyde Park, Mass.; Warren Hunt, Rockland, Mass., and others. Capital stock, $1,000,000.

THE COMLEY COPPER & STEEL WELDING COMPANY, Pittsburg, Pa., has been formed to operate a plant for the electric welding of copper and steel. The directors are: J. W. Comley, Braddock; A. H. Rowand, Jr., Verona; L. J. Long, Pittsburg, Pa. The capital stock of the new company is $10,000.

THE SOUTHERN CALIFORNIA ELECTRIC SUPPLY COMPANY, of Los Angeles, has been incorporated with a capital stock of $50,000; actually subscribed, $20,400. The directors are: Russell H. Ballard, Daniel B. Kearney, George P. Curtis, William L. Percey, of Los Angeles, and Albert C. Jewett, of San Francisco.

THE BOWERY BAY ELECTRIC LIGHT & POWER COMPANY has been incorporated to furnish electricity for lighting and other purposes in Long Island City and Newtown. The directors are George Ehret, John B. Hasslocker and Edward M. Burkhard, of New York City; Louis von Bernuth and Walter C. Foster, of Long Island City. The capital stock of the new company is $10,000.

THE HYRUM ELECTRIC LIGHT & POWER COMPANY, Salt Lake City, Utah, filed articles of incorporation with the Secretary of State. The object of the company is to acquire water powers and develop them for electric lighting as well as for furnishing power for street railways and other plants. The officers of the company will be John F. Wright, president; James L. Jensen, vice-president; James Unsworth, secretary and treasurer. Capital stock, $50,000.

The Telegraph and Telephone.

SPRINGFIELD, MO.—A telephone line has been completed from this city to Aurora.

BELLEVUE, OHIO.—The Bellevue Home Telephone Company has now in service 173 telephones.

SIOUX CITY, IA.—The Nebraska Telephone Company will build a line from Norfolk to Sioux City via Wayne.

MENA, ARK.—The Mena Telephone Company has completed a system in this city and started with 120 subscribers.

NILES, MICH.—Negotiations are in progress in Dowagiac for the purchase of the Gilliland telephone system in this city.

DETROIT, MICH.—The Detroit Telephone Company will lay a cable across the river, and establish telephone service in Belle Isle.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company will next February expend an additional $100,000 in laying conduits.

COLORADO SPRINGS, COL.—The Colorado Telephone Company will erect a $15,000 building, to be fitted for the use of the company.

ARENZVILLE, ILL.—The Illinois Telephone Company has completed its line into Arenzville, and it is expected to reach Beardstown shortly.

DES MOINES, IA.—The Mutual Telephone Company has made arrangements for toll line connection with about 200 towns in Iowa and Missouri.

SEYMOUR, IA.—The Seymour Telephone Construction Company has commenced work on a telephone line between Wayne and Appanoose counties.

CATAWBA, MO.—The Hickory & Newton Telephone Company, which operates in South Carolina, is making arrangements to extend its line from Clarmont to Catawba.

MACON, MO.—The telephone line between Macon and Clarence has been completed, and gives this town communication with any point on the Shelby County telephone system.

QUINCY, ILL.—The Council has granted a franchise to the Farmers & Merchants Telephone Company, which will build a line to various towns in this section of the State.

GALLATIN, TENN.—A new telephone line has just been completed from this place to Scotville, Ky. This gives Gallatin connection with all the towns and villages within a radius of 100 miles.

CANONSBURG, PA.—The Home Mutual Telephone Company has been organized to compete with the Bell Company in this city. A central station will be established and lines built at once.

WEST UNION, OHIO.—A company is being organized to build a long-distance telephone line from Ripley to Georgetown. Such a line would give these places direct connection with Cincinnati.

NORFOLK, MASS.—The Norfolk Southern Street Railway Company is organized. Capital, $150,000. Board of Directors: J. C. Lane, of Norwood, Mass.; Robert S. Gray, of Walpole, and others.

INDIANAPOLIS, IND.—The Interurban Telephone Company, which has its headquarters at Noblesville, this State, has begun the construction of lines to connect with the independent companies operating in other portions of the State.

BOSTON, MASS.—It is stated that the Erie Telephone Company made a net gain of 410 new subscribers during October, and that the increase in its long-distance business during that month, as compared with the business of the corresponding month last year, was 100 per cent.

ST. JOSEPH, MO.—A new telephone line between St. Joseph and twelve towns in Northwest Missouri has been opened. The new line was built by the Northwestern Missouri Telephone Company, and will be connected with the system of the Citizens' Telephone Company of this city.

BIRMINGHAM, ALA.—Bids will be received at the office of the Birmingham Traction Company until Wednesday, December 15, for the electrical equipment of the company's line. Work will be comenced immediately on the letting of the contract. The material required is for the roadway bonding, line suspension, power house, cars, trucks, etc. The power house will be located two miles from one end of the line, and 4½ miles from the other.

ST. JOSEPH, MO.—The Citizens Telephone Company has opened its line to Northwestern Missouri. The following named towns have been brought into

communication with St. Joseph: Rock Port, Tarkio, Fairfax, Milton, Corning, Craig, Mound City, Bigelow, Napier, Forest City and Nodaway.

BRYAN, OHIO.—The Bryan Telephone Company has been organized for the purpose of installing an exchange in this city, to be owned and controlled by home capital and home people. The franchise has already been granted to the company for the purpose of carrying out its enterprise. It expects to start with 100 subscribers.

DECATUR, ILL.—The fight between the Central Union Telephone Company and the Citizens' Mutual Company, a home institution, is still in progress, and the home company seems to be getting the best of the situation. It is stated that the Central Union has in the past few weeks lost about 200 subscribers, who have taken the instruments of the home company instead.

NORTHFIELD, MINN.—The Northfield Telephone Company has completed its extension to Faribault, which puts it into connection with the numerous independent systems covering Iowa, Wisconsin and parts of South Dakota. The local system already has extension to Cannon Falls, Hastings and intermediate points, and connection with the Twin Cities is looked forward to within the next few months.

THE RAILROAD COMMISSION at Raleigh, N. C., has rendered a unanimous decision annulling all previous orders regarding telephone rates. Attorney-General Walser advised the commission that it did not have the power to fix the price of 'phones, but only the transmission of messages. As a result of this action the Long Distance Telephone Company will soon extend its lines in the State.

FOND DU LAC, WIS.—A company has been organized here to build a telephone line along the east shore of Lake Winnebago at Calumet, a distance of 12 miles. The line will connect with the horseshoe line now in course of construction, connecting this city, Calumet Harbor, Winnebago Park, Calumet Village, Malone and Marytown. The names of the officers of the new company are O. F. Waller, president; Theodore Manderschied, secretary; A. C. Dallman, treasurer.

ANDERSON, IND.—The independent telephone companies of Indiana are making an effort to meet the Bell Company on intertown service. At present they have no toll lines, but a company is being organized which will amalgamate all the local companies and construct lines between the different cities and towns. Among the prominent Indiana towns included in the list are Anderson, Muncie, Elwood, Noblesville, Crawfordsville, Lebanon, Lafayette, Rushville, Fort Wayne, Logansport, Columbus and Martinsville. Indianapolis will also be one of the independent towns before the spring opens.

ELECTRIC LIGHT AND POWER.

HARRIMAN, TENN.—An appropriation of $5,000 has been made to improve the municipal lighting plant.

HOUSTON, TEX.—The citizens have voted in favor of issuing $100,000 in bonds to build a municipal lighting plant.

GAINESVILLE, FLA.—An electric light plant is being established in this place. It has a capacity of 50 arc lights and 1000 incandescents.

CUMBERLAND, WIS.—The Cumberland City Council has voted to put in an electric lighting system at once, and has levied a direct tax to cover the cost.

OREGON, MO.—An election will be held here to pass upon the proposition to bond the city for $25,000 to be used in establishing an electric light and water works plant.

HOUSTON, TEX.—At the recent election to pass on the question of municipal ownership of an electric light plant, a majority of votes were cast in favor of the proposition.

SAGINAW, MICH.—Receiver Richard Khuen, of the Saginaw Electric Light & Power Company, has filed a statement showing the assets to be $44,990, and the liabilities $66,400.

HARRIMAN, TENN.—The City Council has voted to purchase an electric light plant, and the city officials have been authorized to sell $5500 worth of bonds, the proceeds of which will be used for the plant.

RENDHAM, PA.—The Taylor Electric Light Company has sold its interest to capitalists from Scranton, Pa., who will erect a new plant at Rendham, and supply current to the following named towns: Taylor, Old Forge, Minooka and Moosic. The machinery will cost $20,000.

COLUMBUS, OHIO, an ordinance has been passed by the City Council providing for the issuing of bonds for the construction and operation of an electric light plant by the city. It provides for the issue of $300,000 in bonds for that purpose. The bonds are to run thirty years at 4 per cent. interest.

WARD, COL.—A special election was held in this city on November 20 on the question of granting the application of Charles W. Betts to establish and operate an electric power plant in this place. The majority of votes was overwhelmingly in favor of granting the franchise. Mr. Betts expects to have the plant in operation by Christmas Day. It will cost $10,000.

KEY WEST, FLA.—The Key West Electric Light & Railway Company is preparing to enlarge its lighting plant, rebuild and extend the street railway and operate its cars by electric power. Mr. Charles Sperry, superintendent and engineer of the company, is now in New York arranging for the material, supplies and construction. Mail may be addressed to him at 12 West Thirty-first Street, where he can also be met by persons interested.

ATLANTA, GA.—The question of municipal ownership of an electric light plant in this city will be taken up by a special aldermanic committee appointed to investigate the matter. Alderman Hirsch, chairman of the committee, has been North for several weeks looking into the subject. Last year the city of Atlanta spent $73,200 for street lights. The number of lights used is 575 arcs and 521 series incandescents.

COLUMBUS, OHIO.—The Council Committee on Gas and Electricity has approved an ordinance providing for a $68,000 bond issue, the proceeds from the sale of which are to be used to build and equip an electric light plant to be operated in connection with the West Side pumping station. It is estimated that 500 arc lights of 2000 candle-power, or 625 of 1200 candle-power, will supply the demand of the different sections of the city, over and above the number of lights the city is compelled to take under the present contract, which does not expire until 1901.

THE ELECTRIC RAILWAY.

ALLEGHENY, PA.—The ordinance granting the United Traction Company certain rights in the city was passed.

LEXINGTON, MASS.—The Lexington Street Railway Company has been granted a franchise to operate its railway in this city.

NYACK, N. Y.—The trustees have granted a franchise to the Nyack Traction Company to operate an electric road in this village.

NASHUA, N. H.—The Portsmouth, Kittery & York electric road is to be extended through New Castle and Rye to Hampton in the spring.

CINCINNATI, OHIO.—The Cincinnati Street Railroad Company has opened its new John Street line, which will be operated for the accommodation of Cumminsville people.

CATSKILL, N. Y.—The Coxsackie trolley road projectors have made application to the Board of Trustees for the right to operate their system over certain streets in this village.

TROY, N. Y.—Work has been commenced on the Oneonta & Otego Valley electric railway. It is expected that 8 miles of track will be laid by January 1. The road will run from Oneonta to West Oneonta, and will be eventually extended to Richfield Springs.

PORT JERVIS, N. Y.—The officers of the electric street railway which is being constructed in this city have received an application from Mrs. Charles Brierly, of Matamoras, Pa., for a position as motorwoman. She states that she has had experience in the running of trolley cars, and is one of the three women in the United States who have been employed as motorwomen.

WEST CHESTER, PA.—The extension of the Philadelphia & West Chester Electric Railway from Newtown Square to this place is likely to be secured within a short time. Trouble has been experienced in the past over the right of way through certain property, but it is now stated that all difficulties in this respect have been adjusted, and that as soon as the papers are signed, the work of extending the line will be commenced at once.

PITTSBURG, PA.—The Westinghouse Electric & Manufacturing Company is building a 250-hp Westinghouse gas engine for the operation of railway generators to be used in connection with experiments on the Turtle Creek branch of the Pennsylvania Railroad. It is proposed to install a storage battery in connection with the plant, and to conduct a series of experiments, which will be of great importance in connection with the operation of interurban and suburban railways.

ELIZABETH, N. J.—At a meeting of citizens and property owners in Union County, held on the night of November 30, it was decided to build a single-track trolley road to be operated by the county. The proposed line will run from Elizabeth to Plainfield. A minority report was submitted against the building of the road, the objection being based on the fact that the county would be bonded to the amount of $1,000,000, and that if the country road was given up the others would go the same way. Committees will now arrange some definite plan.

SOMERVILLE, N. J.—Chancellor McGill recently issued a writ restraining the New York & Philadelphia Traction Company from building or operating its lines in the State, on the understanding that the people of Somerset County objected to the construction of the road, but as the affidavits presented by the defendants showed that the chief objection came from a rival company, he struck out from the order that part prohibiting the company from building or operating in the State. It will be remembered that the New York & Philadelphia Traction Company built a portion of its line on a Sunday recently over some disputed ground, in order to avoid an injunction. Ever since then there has been trouble between the company and the Brunswick Traction Company, with the result that the matter was taken before Chancellor McGill, who issued the injunction. The modification of this injunction enables the New York & Philadelphia Company to go ahead with its work, and the commissioners of South Bound Brook and the Franklin Township Committee have granted the delayed franchise, giving the company right of way from Bound Brook to the Middlesex County line, a distance of over seven miles. The company has agreed to construct its line within ninety days.

PERSONAL NOTES.

MR. H. C. HOAGLAND has resigned his position as superintendent of the municipal lighting plant at Kalamazoo, Mich., to accept that of manager of the Kalamazoo Electric Company's plant.

MR. ALEXANDER BELL, father of Prof. Alexander Graham Bell, it is reported, will, on January 6, 1898, marry Mrs. H. G. Shibley, of Harrowsmith, Ont. He is seventy-eight years of age, and his fiancée is fifty-four.

MR. D. S. KENNEDY, Shamokin, Pa., has resigned his position as superintendent of the Shamokin Street Railway Company and Shamokin Electric Light & Power Company, to accept the superintendency of the Nanticoke Light Company, Nanticoke, Pa.

MR. WOOSTER BLAKE CURTIS, of the General Electric Company, and Miss Julia Marshall Caldwell, of Schenectady, N. Y., were married December 7, 1897. Mr. Curtis is a native of San José, Cal., and an honor graduate of Tufts College. He has been with the General Electric Company for the past five years, during which time he has filled several positions of trust. Mr. Curtis holds a high position in the esteem of his comrades, from all of whom he carries the very best wishes for his future prosperity and happiness.

Legal Note.

THE INDIANA THREE-CENT FARE LAW.—The United States Court of Appeals on December 10, according to an Indianapolis dispatch, dismissed the case involving the question of the constitutionality of the three-cent street car-fare law, passed by the last Indiana Legislature. The decision, it is stated, does not affect the status of the parties in interest. It simply means that the court has no jurisdiction. It is stated that the case will be carried to the United States Supreme Court and tried on its merits. A brief history of this case was published in The Electrical World of June 19, 1897.

Obituary Note.

GARDINER G. HUBBARD, well known to the electrical fraternity through his connection with the development of the telephone and the American Bell Telephone Company, died at his home in Washington, D. C., December 11, at the age of seventy-five years. Mr. Hubbard was born in Boston August 25, 1822, and was graduated from Dartmouth College in 1841. He practiced law between 1843 and 1878, first in Boston and then in Washington. In 1878 he began giving his whole time and attention to the business of the Bell Telephone Company, of which he was the projector and principal stockholder. It was he who interested Professor Bell in the telephone. Mr. Hubbard went to Europe and organized several telephonic companies, among them the International and the Oriental. He purchased the Berliner battery transmitter, which has since become famous in telephone legal warfare, and which still constitutes the most important telephone patent owned by the Bell Company. The telephone system of Russia was established by Mr. Hubbard, who received valuable concessions from that Government. Mr. Hubbard was a strong advocate of Government ownership of railways. He was an eloquent speaker and a man of high attainments. At the time of his death he was, besides his relations with the Bell Telephone Company, president of the National Geographical Society, first vice-president of the American Association of Inventors and Manufacturers, and officially concerned in many other institutions and corporations. His death was due to a complication of diseases, caused or aggravated by old age. The funeral services were held on the afternoon of December 12, and the burial took place in Rock Creek Cemetery, Washington.

Trade and Industrial Notes.

THE WALKER COMPANY has established an office in the Ellicott Square Building, Buffalo, N. Y., and placed it in charge of Mr. R. A. Byrns.

THE HOME AND SOUTHERN ELECTRIC COMPANIES, Richmond, Va., have been granted a franchise by the Richmond City Council to do business in that city.

THE AHLM-EDWARDS ELECTRIC COMPANY, Cleveland, Ohio, has made an assignment to W. J. Hart. The assets of the company are stated to be $9,000, and the liabilities $5,000.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, Ohio, has just issued a catalogue illustrating and describing its full line of machine tools. A copy may be obtained by anyone interested on application.

MESSRS. W. E. KLINE & CO., 123 Liberty Street, New York City, have just issued a little catalogue of miniature incandescent lamps of various sizes and for all purposes. Messrs. Kline & Co. are manufacturers' agents.

"BIG BELTS" is the title of a booklet being produced by Messrs. Charles A. Schieren & Co., the belt manufacturers, 45 and 47 Ferry Street, New York City. The work is now on the press. A copy will be mailed free to any address on application.

A TYPOGRAPHICAL ERROR in the last issue of The Electrical World made the address of Mr. Philip J. Hertz, agent for the Stromberg-Carlson Telephone Manufacturing Company, read 166 Liberty Street, New York, instead of 136 Liberty Street.

MESSRS. PURDY & HIBBARD, successors of Purdy & Sheldon, have opened an office in the Bowling Green Building, 11 Broadway, New York City, where they will conduct a general electrical contracting business and carry a line of electrical supplies.

THE FLUSHING GAS & ELECTRIC COMPANY, Flushing, L. I., has placed the contract for the extension of its generator plant with the Berlin Iron Bridge Company, East Berlin, Conn. This extension will be built in a fireproof manner, having steel framework and trusses covered with corrugated iron roofing.

MUCILAGE AND ELECTRICITY have little in common, but electrical people cannot well do without mucilage. An excellent mucilage pot is that made by the Scattergood Company, 491 Philadelphia Bourse, Philadelphia, Pa. It is a unique article, and is free from all of the objections of the ordinary mucilage bottle.

THE ROSA CURVE TRACER.—Mr. James G. Biddle, 910 Drexel Building, Philadelphia, Pa., has just issued a circular describing the new Rosa electric curve tracer, which was fully described and illustrated in The Electrical World of November 27 and December 4. A copy of this circular may be obtained on application by those interested.

THE C & C ELECTRIC COMPANY, New York, reports having closed a large number of very desirable contracts during the past fortnight for direct connected and belted generators and slow-speed, iron-clad motors of its new types, several of them from foreign countries. It now has on hand contracts for several complete electric power transmission systems.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY, Chicago and New York, announces that it is now engaged in the manufacture of iron-armored outlet boxes of all descriptions, and is prepared to make immediate shipments from 154 Lake Street, Chicago, and 853 Broadway, New York, of any style of box to fit any make of switch or receptacle.

A CORRECTION.—In the article published in the last issue of The Electrical World concerning an automatic focusing photo-engraving lamp, the name of the company which manufactures the lamp was erroneously given as the Manhattan General Electric Company. This error was obvious. The name should have been the Manhattan General Construction Company.

THE GENERAL ELECTRIC COMPANY has recently issued an incandescent lamp catalogue for isolated plants, which should be of special interest and value to all lamp users. The catalogue contains descriptions of the class of lamps used by isolated plants, and much other matter of general and special interest. It is gotten up in an excellent manner, and contains a folder giving the prices of the various types of lamps. A copy of this useful treatise should be in the hands of every purchaser of incandescent lamps.

THE CARBON WORKS of Julius Fuchs in Nurnberg, where "Electra" carbons are manufactured, are now controlled by Messrs. Schiff, Jordan & Co., of New York City. Mr. Fuchs will have charge of these works and the manufacturing department of the Vienna works. Recent and valuable improvements have been made in the manufacture of carbons for the arc lamp, both for alternating and direct current. These carbons will be sold only by Messrs. Schiff, Jordan & Co., whose address is 232 and 234 Greenwich Street, New York City.

MR. PAUL W. BOSSART announces to his friends and the public generally that he has assumed the duties of manager of the Pennsylvania Electric Company, whose plant and headquarters are located at Marietta, Pa. This company has been organized to manufacture a full line of the latest improved high-grade telephone apparatus, embodying new and distinctive features. The company's plant is equipped with the most modern machinery and every facility for producing a fine line of this class of goods. It expects to be ready to fill orders after January 1 next.

MESSRS. WILLIAM H. M'KINLOCK & W. C. CAMP, agents to the successors of the Metropolitan Electric Company, Chicago, have taken a five-story and basement building at 175 Randolph Street, where they will carry on the business of electrical supplies. Their increased facilities at this location promise better attention to their large list of customers. Those interested in electrical matters of any kind are invited to call and inspect the new store. The mammoth catalogue of the Metropolitan Electric Company will be available, and the customers of this firm can use the catalogue numbers and trade words as usual.

THE BURNLEY BATTERY & MANUFACTURING COMPANY, Painesville, Ohio, reports that it has within the last few months received some very flattering acknowledgments of the superiority of its dry battery where a time test or amount of work done is taken into consideration. The company claims that the superior merit of its battery is due to the addition to chloride of zinc of a certain chemical, which it demonstrated by actual time tests to almost eliminate waste by loss of moisture. Heretofore chloride of zinc has been depended upon to maintain the necessary degree of moisture. Dealers can verify for themselves the claims of the company by actually testing the Burnley battery with those of other makes.

THE GAMEWELL FIRE ALARM TELEGRAPH COMPANY, 19 Barclay Street, New York, is ringing the old year out and the new year in with a handsome catalogue of its fire alarm telegraph apparatus, just issued. Few catalogues equal this one in the matter of artistic design and typographical execution. The olive green cover is handsomely embossed with representations of various alarm devices, and in the centre is an illustration in red of the front of a street fire alarm box. The reading pages, which contain very beautiful half-tone illustrations of the company's apparatus, give a history of the fire alarm telegraph service and a description of the modern and complete system of the Gamewell Company.

WALKER COMPANY APPARATUS.—The Metropolitan West Side Elevated Railroad Company, Chicago, which is equipped with General Electric Company's apparatus, has recently placed a large order for additional motors with the Walker Company. A similar departure has been made by the New York, New Haven & Hartford Railroad Company, part of whose General Electric apparatus will be supplied with current through a Walker switchboard, now being constructed at New Haven, Conn. Among the foreign orders that are being filled by the Walker Company at the present time may be mentioned four special belt-type generators of 38-kw capacity each, which are being built for the town of Lecce, Italy, to be used in connection with a storage battery plant for electric traction. In addition to these generators, the Japanese Government has ordered for its own use one 100-hp stationary motor for power, designed to run at 300 revolutions per minute on a 200-volt circuit.

THE KEYSTONE TELEPHONE COMPANY, Pittsburg, Pa., has just installed a 900-drop full metallic switchboard at Youngstown, Ohio, and has just closed a contract with the Home Telephone Company, of Oskaloosa, Ia., for a 400-drop full metallic switchboard. It has also received a contract for 100 telephones and switchboard for Kallispell, Mont.; 200 telephones and switchboard for Moundsville, W. Va., and 100 telephones and switchboard for Wellsburg, W. Va. The company has just completed an exchange at Washington Court House, Pa., for 300 telephones and switchboard, and now has a contract at Washington, Pa., for 400 telephones and switchboard. It has also installed in the plant of the Phœnix Telephone Company, at Steubenville, Ohio a 500-drop switchboard and a 100-drop switchboard at Mingo Junction, Ohio. Beside these contracts the company has several large ones for its late design long distance instruments, to go to all parts of the United States. The company's trade at this time of the year is reported to be exceedingly good.

THE "STANDARD" SYSTEM OF TIME DISTRIBUTION, which is controlled by the Standard Electric Time Company, Waterbury, Conn., is giving excellent satisfaction wherever it is in operation. The master clock of the system is a self-winding regulator, which beats seconds. This controls the secondary clocks which may be distributed throughout a building or a district. The system includes, besides the master and secondary clocks, a battery tell-tale, which shows the condition of the battery; an indicator clock, an alarm bell, a

cut-out switch and a jumping key. The circuit is closed by the master clock every sixty seconds, and at the same time the tell-tale is thrown in circuit and indicates the strength of the current. The alarm bell is so connected up that it will ring when the battery needs attention or should the wires become deranged. The indicator clock is for comparing the time on the secondary clocks with the master clock. The switch is used to disconnect the secondary clocks from the master clock, and the jumping key sets all the secondary clocks at one time.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has just closed a contract with the Chicago Edison Company for a storage battery plant with a capacity of 7,436,800 watt hours. This, it is stated, will be the largest battery installation ever made. The contract includes switchboard and all auxiliary apparatus, and will be completed in March, 1898. This installation will be an object of great interest to the members of the National Electric Light Association at their next meeting, which is to be held in Chicago in June, 1898. The Battery Company has also closed a very important contract with the Buffalo Railway Company. The battery is to be used in conjunction with power furnished by the Cataract Construction Company at Niagara, over its high tension transmission lines to Buffalo. This is a most important development, and one which, it is said, is being watched with intense interest all over the world. Both of the batteries above referred to will be the largest for their purpose ever installed. The year's business done by the Electric Storage Battery Company shows a very remarkable increase over preceding years, and indications are that the coming year's business will far exceed the results of the present year.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S factory at East Pittsburg, Pa., is at the present time very busy on a number of electrical machines, all intended for concerns at Niagara Falls and in the vicinity of the great electric power centre. It will be remembered that about six months ago the Cataract Construction Company contracted with the Westinghouse people for a large addition to the power station, consisting of five 5000-hp generators of the same pattern as the three already installed. In addition to these five machines, which are now under way, in fact shipment has already commenced, the factory is also building exciters, representing a capacity of 675 horse-power. The switchboard, with necessary appliances, controlling the five 5000-hp generators is also being made, and all of these machines will be installed in the Niagara power house as soon as required. The Niagara Falls Hydraulic Power & Manufacturing Company some time ago contracted with the Westinghouse Electric & Manufacturing Company for six 750-hp direct current generators, 300 volts, 250 r. p. m. These generators will be direct connected to Leffel turbines, and they will be used for generating current that will be supplied to the aluminum factory of the Pittsburg Reduction Company at Niagara. The Westinghouse Company has also constructed two 300-hp, two-phase induction motors contracted for by the Buffalo-Niagara Falls Electric Light & Power Company. These motors will be used for driving alternating current generators, direct current generators, arc machines, etc. The Niagara Electro-Chemical Company has contracted for a large increase in its transformer station, located above the power house of the Niagara Falls Power Company, consisting of three 235-hp, two-phase rotary transformers and one 175-kw rotary transformer, supplying current for the reduction of metallic sodium from caustic soda. In addition to these transformers the Westinghouse Company is also making for the same concern 800 horse-power in air-cooled oil converters, consisting of six 133-hp converters of 3000 alternations, which will supply current for the rotaries. The Acetylene Light & Power Company has contracted for two 1000-hp oil converters, water cooled, of 3000 alternations; primary, 2200 volts; secondary, 100 volts. These converters will supply current for arc furnaces for the manufacture of calcium carbide. The Mathieson Alkali Company contracted with the Westinghouse Company some time ago for a number of rotary transformers, induction motors and oil converters, which were recently installed. The contract included eleven 165-hp rotary transformers, several small induction motors, twenty-two 82½-hp. oil converters, four 33½-hp oil converters and two 13½-hp oil converters. These facts are the best evidence of the growing activity manifesting itself in the use of electrical apparatus at Niagara Falls, all of which has been occasioned by the erection of the large power station of the Cataract Construction Company, the generators for which were installed by the Westinghouse Electric & Manufacturing Company.

Business Notices.

PICTURES TELL THE STORY of how everything looks in South Dakota as the result of the great crops of the last three years. The Chicago, Milwaukee & St. Paul Railway Company has had photographs taken of actual farm scenes in South Dakota, and has had them reproduced in an attractive eight-page illustrated circular, which it is distributing free of cost to all who are looking for new homes in the most fertile section of the Middle Northwest. Send your address to H. F. Hunter, Immigration Agent for South Dakota, 291 Dearborn Street, Chicago, Ill., or to W. E. Powell, General Immigration Agent, 410 Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 7, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

594,872. ELECTRIC SOLDERING IRON; F. H. Harriman, Hartford, Conn. App. filed April 17, 1897. In an electric soldering iron the combination of a soldering head constituting one terminal of an electric circuit; a conducting shell surrounding and insulated from the stem of said soldering head, and filled with a comminuted carbonaceous material, and constituting the other terminal of the circuit; and a handle connected with said soldering head.

594,879. POTENTIAL SWITCH; J. D. Ihdlèr, Yonkers, N. Y. App. filed Oct. 15, 1896. A switch having two sets of terminals, a cup-shaped housing, inclosing a magnet, an armature thereon having a lug, a lever mounted on the housing and having a catch engaging the lug on the armature, the lever being under stress of a spring.

594,882. ELECTRIC CABLE; J. H. Kelman, Pittsfield, Mass. App. filed Sept. 25, 1897. A cable consisting of several conductors, each separately coated with a continuous coating of varnish hardened by oxidation, and a covering holding said conductors together in close proximity.

594,908. FUSE PLUG; D. A. Schutt, Peru, Ind. App. filed April 16, 1897. A fuse plug consisting of a base of insulating material, a centre metallic post provided with a fuse connection at the top and internally threaded in its base, a metallic contact in the side of the base, with a connecting screw extending through to the top and provided with a fuse connection, and a fuse attached to such connection.

594,913. TROLLEY CONNECTION FOR CANAL BOATS; F. J. Shewring, Toronto, Canada. App. filed March 11, 1897. A trolley system for canal boats, consisting of a main circuit, a trolley wire, a trolley wheel mounted on the main circuit wire, a vertical frame for the trolley wheel, composed of two sides united at the top, an eye connected to the top of the sides, a hanger depending from one of the sides below the wheel, a horizontal extension by the hanger projecting under the vertical axis of the wheel, a vertical extension depending from the horizontal extension, a balance connected to the end of the vertical extension, a circuit wire elevated above the main circuit wire at canal junctions to allow of the free transit of the boats passing beneath, a trolley wheel mounted on the elevated circuit wire, a hanger depending from the trolley wheel, having a hook-shaped end to engage the eye of the principal trolley wheel.

594,917. ELECTRIC BATTERY; W. Mont. Storn, New York, N. Y. App. filed Dec. 8, 1896. In an electric battery, an absorbent layer provided with a number of small glass tubes or chocks for preventing the compressing of the material.

594,928. ELECTRIC ARC LAMP; H. M. Baker, Jr., and A. W. Fox, Brooklyn, N. Y. App. filed Feb. 24, 1897. In combination, a holder provided with a plain wheel, a second holder also provided with a plain wheel and a compound right and left screw rod, the axis of each of the plain wheels being located in lines parallel to the circumferential surface of the screw rod.

594,932. TERMINAL FOR ELECTRIC CONDUCTORS; W. P. Booth, South Bend, Ind. App. filed Dec. 16, 1896. In combination with a pair of resilient conducting strips, and electrodes contacting thereby, a plug having multiple contacts of conducting material mounted on one side of a body of insulating material and adapted to form a connection between the pair of resilient strips or electrodes to test either the incoming or outgoing circuits.

594,944. ELECTRIC SWITCH; F. A. Gilbert, Brookline, Mass. App. filed Dec. 18, 1896. In an electric switch, fixed terminal members, a co-operating two-part member, the mechanically unconnected parts of which are electrically connected and independently movable, and an actuator for said two-part member.

594,946. CONTROLLER FOR MOTORS AND BRAKES OF ELECTRIC CARS; A. Grossman, New Orleans, La. App. filed Aug. 31, 1897. A mechanism for controlling the motor and brake of an electric car, comprising a rotary brake shaft, a handle so connected with the staff that it will turn in one direction with said staff, and in the opposite direction loose on the same, a gear wheel loosely mounted on the staff, a suitable means for holding said gear wheel against casual rotation, suitable means for detachably connecting said gear wheel with the handle, and a rheostat or switch shaft connected by gearing with said gear wheel.

594,979. TELEPHONIC SELECTIVE SIGNALLING. J. A. Barrett, Brooklyn, N. Y. App. filed March 1, 1897. The combination in a signalling circuit, of a motor receiving instrument, comprising a fixed system of armature coils surrounding a core or series of cores, and a permanent rotary field magnet mounted within the space surrounded by said cores, and of two or more circuit conductors connecting said coils, the number of circuits being less than the number of coils, with an electric-current generator and a selective signal and current controlling transmitter, comprising means for creating different relations between the ends of said conductors and the poles of said generator, and for combining any two of said conductors into a circuit and sending currents of either direction through said circuits, thereby establishing magnet poles at desired points on said armature core.

594,998. CONDUIT FOR ELECTRIC WIRES; R. W. Lyle, Perth Amboy, N. J. App. filed Oct. 1, 1897. A conduit for electric wires having longitudinal and transverse scorings in its body to facilitate the removal of sections thereof.

595,004. TELEPHONE CIRCUIT; G. K. Thompson, Malden, Mass. App. filed July 23, 1897. The combination in a telephone system of a number or group of sub-station circuits, each extending to switch connections upon the switchboard sections at a central station; a line signal, and signal and circuit controlling devices for each circuit; with a switch-cord circuit having two main circuit and one local circuit conductors, a supervisory signal in the circuit conductor, an electromagnet controlling by a shutter or like device the display of said signal in one of the said main circuit conductors, a bridge uniting the said three conductors, and a battery included therein, and provided with separate normal connections between its poles and the end of the main conductors, whereby the said battery is enabled to supply current for all of the several circuits and signals concerned.

595,008. ELECTRIC RAILWAY; G. Westinghouse, Pittsburg, Pa., and W. Chapman, Washington, D. C. App. filed Oct. 31, 1896. In an electric rail-

way, a contact rail formed of channel or angle iron, in combination with insulating supporting blocks, and longitudinally extending rods or bolts, one for each block, provided with laterally extending clamping devices whereby the rail is held against lateral movement.

595,078. MULTIPLE CIRCUIT BLOCK; D. A. Schutt, Peru, Ind. App. filed April 16, 1897. A circuit block for use in making branch electrical connections, consisting of two or more sections of insulating material secured together by metallic bars at the back, main-wire sockets with fusible electrical connections to the bars, and branch connections through the block, and to binding screws at the side.

595,080. TROLLEY ARM FOR ELECTRIC RAILWAYS; S. H. Short, Cleveland, Ohio. App. filed Sept. 26, 1896. The combination of a trolley arm and two fork arms, with a Y-shaped connection, uniting said arm and fork arms, and a roller mounted in the upper ends of said fork arms.

595,081. ARMATURE FOR DYNAMO ELECTRIC MACHINES; S. H. Short, Cleveland, Ohio. App. filed March 11, 1897. A separate lamina for a dynamo electric machine, having peripheral teeth, the ends of which are bent at right angles.

595,084. CLOTH CUTTING MACHINE; G. Swope, Chicago, Ill. App. filed Feb. 27, 1897. A cloth cutting machine, comprising a flat, vertically reciprocating cutter, two motor coils, arranged one above the other, a reciprocating core or plunger to the lower end of which the cutter is rigidly attached, a flat, horizontal base plate, and a thin, vertical standard, which rises from the base plate and supports the parts of the machine above the same, said standard being provided with a vertical groove which extends inwardly from its front edge, and in which the current slides or moves.

595,086. ELECTRIC ELEVATOR CONTROLLER; C. M. Weymann, San Francisco, Cal. App. filed Jan. 27, 1897. The combination with an electric motor and an elevator mechanism moved thereby, of a mechanism comprising solenoids having movable cores and mechanism actuated by the cores whereby contacts are produced and the direction of the motor first established, a controlling device whereby both armature and field resistance are varied proportionately to the desired motor speed, and an automatically operating device comprising an electric clutch within the circuit which is established through the solenoids, and intermediate mechanism whereby the controller is disengaged and returned to its normal position.

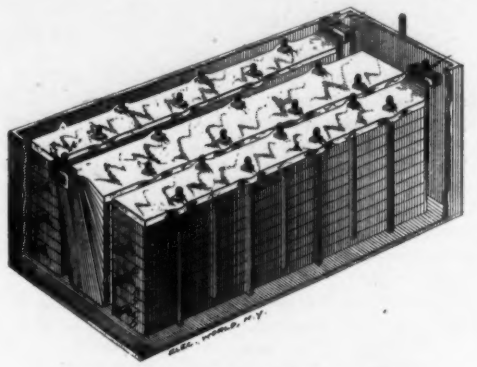
595,089. THIRD RAIL INSULATOR; A. Anderson, Boston, Mass. App. filed July 23, 1897. In an insulating support, the combination with a metallic hood provided with longitudinal sockets on its inner side, of a metal bolt having its head and shank enveloped by a covering of insulating material, longitudinal ribs on the insulated head engaging the longitudinal sockets in said hood, and a base to which said bolt is secured.

595,096. ELECTRIC ALARM DEVICE; L. Fitz Gerald, Hartford, and J. Fay, Yalesville, Conn. App. filed Feb. 12, 1897. In an electric alarm device, a circuit closing apparatus, consisting of an electromagnet, mounted in a casing, which consists of an end plate, an angle plate connected by transverse bars or bolts, said plate being provided with an extension having jaws, an armature pivotally connected therewith, the lower end of which is adapted to operate in connection with the core of the said magnet, a spring secured to said plate, the upper end of which bears against the said armature, and adapted to hold the same out of contact, a transverse rod or bar secured to the casing in which the said magnet is mounted, and provided with an arm secured to the end of said rod or bar, and which projects in a direction opposite to that of the arm, and provided with a cross-head adapted to operate in connection with the lower end of the armature, said magnet being connected with a suitable battery, and when the said armature is actuated by the said magnet, the said plate is adapted to fall by gravity and close the circuit through the conductors.

595,132. SECONDARY BATTERY; R. Ashley, Port Republic, N. J. App. filed Oct. 9, 1896; renewed July 17, 1897. In a secondary or storage battery, the combination with the cell, the negative electrodes located therein, consisting of U-shaped conducting frames, a series of superimposed troughs provided with integral end pieces, and the conductors located in said troughs, and their ends connected with the frame, of the positive electrodes, consisting of a number of superimposed lead plates, having their ends bent backward onto and secured to the main portion, so as to form spaces between said plates.

595,208. STORAGE BATTERY; J. D. Rively, Pittsburg, Pa. App. filed Feb. 19, 1897. In a storage battery, the combination of a series of electrodes arranged horizontally within said casing, a vertically arranged insulating plate in the casing dividing said series into cells, a metallic perforated feed pipe connecting said cells and forming a path for the current from one cell to the other, and suitable connection between said electrodes and the binding post carried by the casing.

595,224. UNDERGROUND TROLLEY SYSTEM; L. E. Walkins, Springfield, Mass. App. filed May 17, 1897. An underground trolley system for electric railroads, comprising a conduit, suitable frames for supporting said conduit, rails supported on said frames, a cover for said conduit secured to the edges thereof, and having a continuous longitudinally central slot therein, an insulating material for lining said conduit and for forming longitudinal partitions therein, supports for said cover between the top of said partitions and said cover guard plates of insulating material extending from the under side of said cover, near opposite edges of said slot, downward, to a point beyond the upper edge of said partitions, insulated trolley rails on said partitions and the under side of said cover, a trolley carriage for said rails



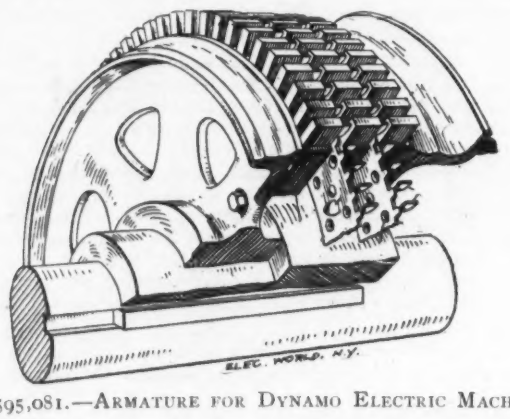
No. 595,208.—Storage Battery.

having trolley arms extending therefrom upward through said slot in the cover for connection with a motor of an electric car, line wires in separate compartments of said conduit, and connections from said line wires to the trolley rails on one of said partitions, and from said trolley carriage to a motor and return, and from said trolley carriage to the rails on the other of said partitions.

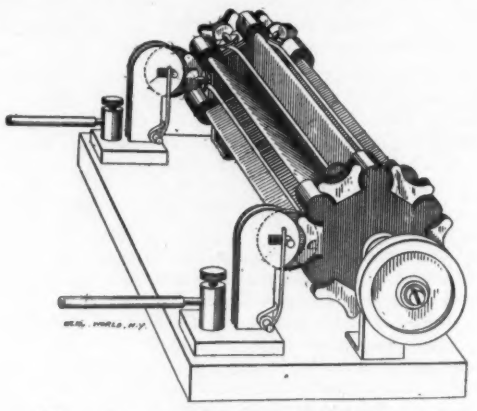
595,238. ARMORED CONDUIT; E. T. Greenfield, New York, N. Y. App. filed July 27, 1897. An armored conduit consisting of a flexible interior insulating tube, and one or more spirally wound layers of metal secured thereto.

595,241. CENTRAL STATION COMBINED TELEGRAPH AND TELEPHONE SYSTEM; A. C. Robbins, San Francisco, Cal. App. filed March 26, 1897. An improved telegraph and telephone signal system, consisting of a central station, a fulcrumed lever at said station, a suspended removable receiver and contacts at opposite portions of said lever, alternately made and broken by the suspension or removal of the receiver, an alarm and a local battery circuit at the central station for operating the same, a relay actuated by the main-line current and controlling contacts in said local circuit, and an independent contact with which the said lever engages, said last-named contact being closed when the receiver is suspended and open when the receiver is removed.

595,243. AUTOMATIC RECORDER FOR ELECTRICALLY OPERATED RAILWAY GATES AND SIGNALS; J. M. Williams, Danville, Va. App. filed July 28, 1897. In an automatic recorder for electrically operating railway gates and block signal systems, the combination, with the shaft thereof, of the endless ribbon, sheet or strip, means for carrying said ribbon, an



No. 595,081.—Armature for Dynamo Electric Machines.



No. 595,244.—Magazine Fuse Block.

electrical recording or marking device for acting upon said ribbon, means for moving the ribbon both longitudinally and laterally for receiving a spirally arranged record and a circuit make-and-break device, and electrically connected to said recording or marking device.

595,244. MAGAZINE FUSE BLOCK; W. Ehrhardt, Union Hill, N. J. App. filed Aug. 10, 1897. In a magazine fuse block, the combination of a rotary cylinder or shaft, provided with star-shaped end pieces, the arms of which terminate in rounded formations of insulating material, contact clips to which the fusible strips are connected, located between the said rounded projections, and spring mounted rotating discs adapted to make connection with said contacts, and to roll over said rounded projections when the block is shifted.